# STERRAD® 100 Sterilization System Service Guide

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This guide contains information on servicing the STERRAD® 100 S Sterilizer. The STERRAD 100 S Sterilizer is for international use only. No use other than testing related to the development and submission of information to the FDA is authorized in the United States.

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# Chapter 1

# About the Service Guide

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# Introduction

This service guide is designed to provide you with complete information needed to service the STERRAD® 100 Sterilizer and the STERRAD **100 S** Sterilizer.

The **System Messages** section may be the most valuable section for you. It contains all the messages generated by the system (more or less in alphabetical order). Also in the system messages section are system problems that do not always generate a message. Be sure to check those out too, when troubleshooting a system.

The Subsystem section contains the information about all the identified subsystems within the STERRAD system. Each subsystem section contains the theory of operation for that subsystem, calibration procedures, removal and replacement.

The STERRAD icon next to a paragraph, like this one, indicates that the information is related to a configuration other than Block 1.8 (usually **Block 2**)

# What's New in this Guide?

## NEW FOR REV D!

- ✔ The on-line version contains VIDEO clips. The service guide can be run from a CDROM. The video clips are available for viewing by just clicking on the video tape icon. The videos have sound (you need a sound card) and can be replayed as many times as you wish. The video clips are located in the PM section and in the removal/replacement sections for the door and feedthrough.
- ✔ The parts lists have been eliminated. The STERRAD Sterilization Systems Parts Book contains all the parts available for the STERRAD 50, 100 and 100 S Systems. STERRAD 100 SI GMP Sterilizer parts are contained in a separate Parts Book addendum.
- ✔ The PMs are now designated as Level 1 (750 cycles) and Level 2 (1500 cycles).
- ✔ Extensive upgrades and configurations, including the international system configurations have been added to the manual as a separate section.
- ✔ A separate troubleshooting section has been added. This "tree" steps you through a series of procedures to help you troubleshoot various system problems, particularly with the RF subsystem, before swapping out expensive parts.

- ✔ As of this publication, there is a plan to replace the current exhaust filter with a catalytic converter. Replacement procedures for this converter are similar to those now given for the exhaust filter. The PM video clips show a prototype of this converter.
- ✔ The schematics are viewable on-oine using an Adobe Acrobat Reader. This reader is available from ASP and is also downloadable from the ASP Bulletin Board Service and at various locations on the Internet.

# Revision C Information

**STERRAD 100 S Sterilizer** information is included. When servicing a STERRAD **100 S** Sterilizer you should perform all procedures according to the model type (Block 1.8 or **Block 2**.) If the servicing procedure is different because of the STERRAD **100 S** Software, this is noted in the text and you should be certain you are performing the correct procedure for a STERRAD **100 S** System.

A number of minor errors in the text have been corrected in this revision. These errors were noted and the correct information previously sent in several service and technical bulletins. The new SMC switch settings are included and the correct test is provided for the Baratron Zero Shift Test

All references to the Service Test PCB have been removed. You are now directed to use AutoTest where applicable.

# REV A/B Information

The STERRAD 100 Sterilization System is constantly being upgraded to provide better operation and to make field maintenance easier. Because of this, a number of new parts and procedures now exist for the STERRAD 100 that are known as **Block 2**.

This guide features those **Block 2** changes, as well as other configuration differences. Unless indicated in the notes, the differences are those parts and procedures that have changed from Block 1.8 to **Block 2**. Some procedures you have performed in the past are eliminated in **Block 2**.

It is important to note that the installation chapter features **Block 2** installation information with the exception of the installation of the seismic restraint information.

# What's New Table

The What's New Table features brief descriptions of various changes to the STERRAD 100 sterilizer that make up **Block 2** and information on STERRAD **100 S** differences. Where **Block 2** components and procedures changed from Block 1.8 or where information on older components is presented, these are noted in the table and detailed in various sections in the guide. Also, information that has changed or been added after the previous manuals (rev A and B) was published is noted in the table.

| Section | Differences | Notes |
|---|---|---|
| **General Information** | Service Test Board is no longer used and all references to it have been removed. | Change from rev B |
| **NEW!** | Cycle designation changed from Scope/No Scope to Long Cycle and Short Cycle respectively. | . |
| | STERRAD **100 S** Sterilizer information added including theory test parameter changes and parts information. | |
| | System Messages have been updated to reflect changes in software. "Call Customer Service" has been replaced with "Call Technical Service." | Change from rev C |
| **Vacuum Subsystem** | Vacuum pump switch has a new type of setting procedure. | |
| | Oil return valve is now part of the vacuum system. | |
| | Ballast valve lever is located on top center of the D16A vacuum pumps. | D16A pumps are no longer supplied. However there are many still in use in older machines. |
| | SMC switch has new settings. | Change from rev B |
| | If a STERRAD 100 System is being upgraded to use the STERRAD 100 S Software and it has a D16A pump, the pump must be upgraded with an oil return system. | |

| Section | Differences | Notes |
|---|---|---|
| **Injection Subsystem** | Injector valve height calibration has a new procedure. | |
| | Injector pump valve can now be adjusted. | |
| | All Block 1.8 systems require an upgraded injection system to support the STERRAD 100 S Software. Some Block 1.8 systems have the upgraded injection system regardless of the type of software used. | Change from rev C |
| **Door and chamber subsystems** | Door and chamber thermocouples are in a different location and are tested in a different manner. | |
| **NEW!** | Removal and replacement of the door and feedthrough are augmented in the on-line guide with video clips. | |
| | Guide rail alignments have changed. | |
| | Door open/close speed setting have a new procedure. | |
| | The door solenoid features a safety lock. | Change from rev C |
| **Controller Subsystem** | Pin connectors on control panel are different and in different locations. Analog to digital set point test points are in a different location. | |
| | Analog to digital set point test point are in a different location. | |
| | Microprocessor PCB is different | |
| | All STERRAD 100 S Systems have a Z180 CPU. | Change from rev C |
| **AC subsystem** | AC circuit breakers are on the exterior of the system in **Block 2**. | |
| **User Interface** | The **Block 2** membrane switch has different removal procedure. | |

| Section | Differences | Notes |
|---|---|---|
| | User software available in more language choices. | |
| | STERRAD 100 S software substantially changes system operation due to change in injection and cycle time. | Change from rev C |
| | If a Block 1.8 system is upgraded to use the STERRAD 100 S Software, he membrane switch must be changed to accommodate the software and language differences. | |
| **Installation** | The entire chapter presents procedures for **Block 2** devices only. | Contact ASPS if you have occasion to install a Block 1.8 device. |
| | Seismic restraint installation for both Block 1.8 and **Block 2** are presented. | Change from rev A Service Guide. |
| | A drilling template is included in the seismic installation kit. This template is provided for the customer to aid in the accurate placement of the restraint hardware. | |
| **Planned Maintenance** | PM procedures are augmented in the on-line guide with video clips. | Change from rev C |
| **NEW!** | Planned Maintenance is now designated as PM Leve 1 and PM Level 2 | |
| **NEW!** | Two kits are now available for PMs. PM1 (750 cycles) and PM2 (1500 cycles). | Change from rev C |
| | An air filter is now on the rear panel. | |
| | D16A pump has a different procedure for draining/replacing the pump oil and filter and a different fill indicator. | D16A pumps are no longer supplied. However there are many still in use in older machines. |
| | Exhaust filter oil is not drained on **Block 2** devices | |
| **NEW**! | A vaporizer plate is now attached to the electrode. It is easily removed for cleaning. | . |

| Section | Differences | Notes |
|---|---|---|
| | The paper ribbon and cassette collection box are no longer part of the PM procedures. These are now customer maintenance items only. | |
| **Product Certification** | Analog to digital set point test has new test points and trim pot adjustments. | |
| | Door and chamber temperature checks have different test points different trim pot adjustments and a different verification procedure. | |
| | Baratron Zero Shift test added to certify capacitance manometer. Error in text corrected. | Change from rev A Service Guide. Error correction to rev B. |
| **Technical Data** | User interface has a multi-language control panel that is interchangeable. | More languages are available for the control panel and software. Change from rev A Service Guide. |
| **Parts List** | This section has been eliminated. Parts are now contained in the STERRAD System Parts Book. | |
| **AutoTest** | Autotest procedures updated and corrected. | Change from rev A Service Guide. |
| | SMC switch settings updated per manufacturer's recommendation. | Change from rev B Service Guide |

A Publication Change Request form is available for your use. Please fax or mail it back with your suggestions, comments and correction. If you wish, using the form as a guide, email your information. The email address is: RTAPPY@aspus.JNJ.COM. Be sure to enclose your full name, location phone number and fax number.

# Chapter 2

# System Operation

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# Introduction

The STERRAD® 100 Sterilizers are intended for use in hospitals and other medical service institutions for the purpose of sterilizing medical instruments and other equipment. The product employs the proprietary STERRAD Hydrogen Peroxide Gas Plasma Sterilization Process to achieve $10^{-6}$ Sterility Assurance Level (SAL) in a cycle time of approximately 75 minutes (51-72 minutes for the STERRAD **100 S** System). This process does not create toxic by-products nor dangerous heat levels and requires no special venting or piping. Many types of medical instruments and equipment can be safely and completely sterilized with this process.

This section presents the general Theory of Operation for the STERRAD 100 Systems. Each subsystem section has more detailed theory about the subsystem.

Remember, when you see the STERRAD icon, as with this paragraph, this indicates that the information pertains to a different system configuration other than the standard Block 1.8 system.

# Theory of Operation-Overview

The STERRAD Sterilization Process occurs in the following manner:

- The items to be sterilized are placed in the sterilization chamber, the chamber is closed, and a vacuum is drawn.
- An aqueous solution of hydrogen peroxide is injected into the chamber where it vaporizes, surrounding the items to be sterilized.
- After a period of hydrogen peroxide diffusion, the pressure is reduced in the chamber. The formation of a low-temperature gas plasma is initiated by applying radio frequency (RF) energy to create an electric field.
- In the plasma state, the hydrogen peroxide vapor breaks apart into reactive species that include free radicals.
- The combined use of hydrogen peroxide vapor and plasma, safely and rapidly sterilizes most medical instruments and materials without leaving toxic residues.
- Following the reaction, the activated components lose their high energy and recombine to form primarily oxygen, water and other non-toxic by-products.
- When the process is complete, the RF energy is turned off, the vacuum is released and the chamber is returned to atmospheric pressure by venting through a High Efficiency Particulate Air (HEPA) filter. The items within are sterilized and ready for use.

# Routine Maintenance

The operator is required to perform maintenance as detailed in the Operator's Manual. The operator maintenance includes cleaning the injector valve vaporizer bowl, replacing the printer ribbon and replacing the cassette collection box. Printer paper is replaced as needed.

In addition to the routine maintenance performed by the operator the service technician performs these activities:

- Complete the planned maintenance procedure and product certification at 750 cycles or 6 months using the PM1 kit.
- Complete the planned maintenance procedure and product certification at 1500 cycles using the PM2 kit.

## *Service Philosophy*

Sterilizer servicing is limited to the service activities described in this guide. All planned and corrective maintenance activities must be performed by ASP or its authorized representative. Unauthorized repairs void the warranty.

## *The Sterilization Cycle*

The sterilization cycle is automatically controlled by a programmed microprocessor that monitors operating parameters and controls each of the five stages of the cycle. The operator interacts with the system through the control panel, a status indicator display, and a two-line alphanumeric display.

When the operator has loaded the process chamber and pressed the **START** button, the door automatically closes and the five stage sterilization cycle proceeds. The five stages are as follows:

- **Vacuum** - The atmospheric pressure in the process chamber is reduced to 300 mTorr.
- **Injection** - Hydrogen peroxide is initially vaporized into the process chamber.
- **Diffusion** - Then the hydrogen peroxide vapor is allowed to diffuse to all areas of the load for a fixed time period.
- **Plasma** - RF energy ionizes gases within the process chamber.
- **Vent** - Filtered air is admitted into the chamber, and then returned to atmospheric pressure.

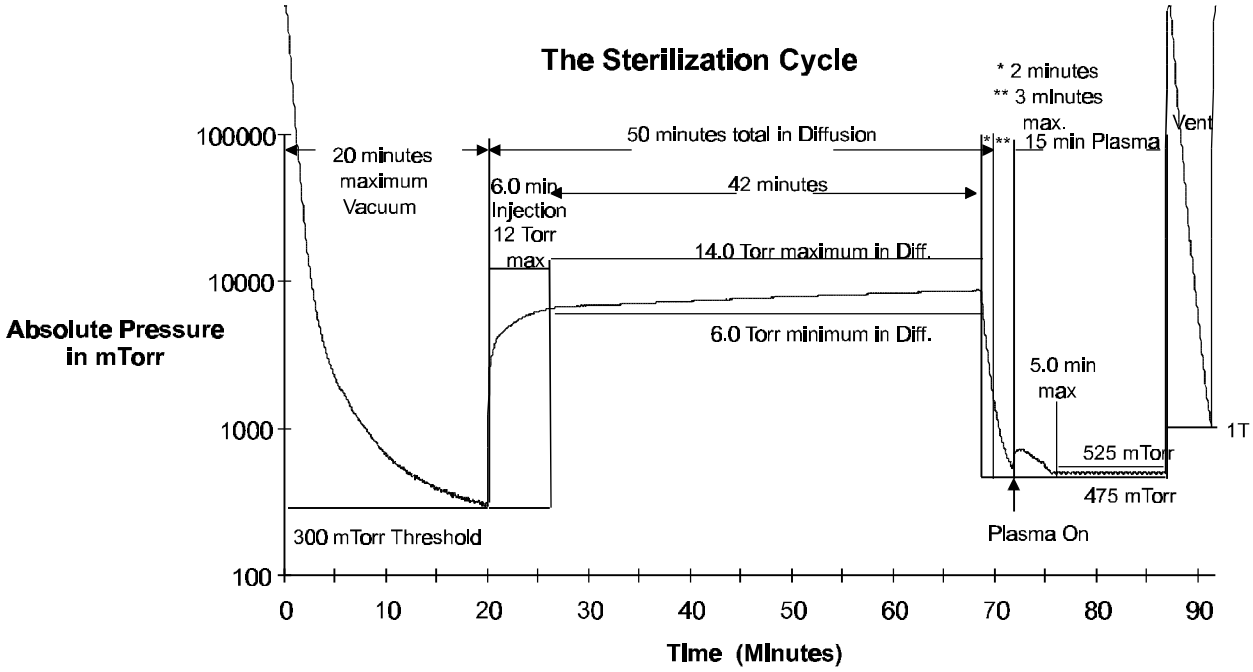


***Figure 2-1. The Sterilization Cycle***

Electrical energy at high frequency is used to break down hydrogen peroxide ($H_2O_2$) molecules into an unstable ionized state called a low temperature plasma. The combination of hydrogen peroxide vapor and plasma safely and rapidly sterilizes most medical instruments and materials without toxic residues. At the end of the process, the active species in the plasma lose their high energy and recombine to form stable compounds such as oxygen, water, and other non-toxic by-products.

At the end of the cycle, or following a problem with the cycle at any stage, the system presents an appropriate message on the front panel display and prints a status report. If the cycle was interrupted by an apparent malfunction, the printout indicates the reason for the interruption and suggests appropriate corrective action.

## *Process Parameters*

| Item | Min. | Max. |
|---|---|---|
| **Temperature** | | |
| Chamber and Door | 42°C | 50°C |
| **Vacuum Stage** | | |
| Time | 0 minutes | 20 minutes |
| Pressure | 300 mTorr | 300 mTorr |
| **Injection Stage** | | |
| Time | 6:00 min:sec | 6:02 min:sec |
| **Pressure** | | |
| first 10 seconds | 300 mTorr | none |
| after 6 minutes | 6.0 Torr | 12.0 Torr |
| **Diffusion Stage** | | |
| Time | 42:00 min:sec | 42:02 min:sec |
| Pressure | 6.0 Torr | 14.0 Torr |
| **Diffusion Pump Down Phase** | | |
| Time | 2:00 min:sec | 2:01 min:sec |
| Pressure control point | 475 mTorr | 525 mTorr |
| **Plasma Stage** | | |
| Delivered power | 365 Watt | 450 Watt |
| Pressure | 475 mTorr | 525 mTorr |
| | | |

| **Vent Stage** | | |
|---|---|---|
| Time | 4 minutes | 9 minutes |
| Pressure at Completion | 690 Torr | 760 Torr |

### Vacuum Stage

| Duration | Parameter | Limit |
|---|---|---|
| Variable | Time | 20 minutes max. |
| | Pressure | 300 mTorr |
| | Temperature | 60 ms 10 C Alarm<br>40-50° C Control |
| | Preheat vaporizer time | 0 - 5 min. ON<br>5 - 20 (max.) min.<br>60% ON - 40% OFF |

Air is pumped from the process chamber, reducing pressure from atmospheric (760 Torr) to 300 mTorr. This stage normally lasts 5 to 10 minutes. If pressure is not reduced to 300 mTorr within 20 minutes, the cycle is automatically restarted.

If a pressure of 700 mTorr is reached within the first 5 minutes of the vacuum stage, the RF power is turned on to initiate a plasma. This dries the load and prevents “vacuum not low enough for injection” failures. The RF power is then turned off when the pressure reaches 300 mTorr or 15 minutes into vacuum stage.

If a pressure of 1 Torr or less is not reached within the first 9 minutes of the vacuum stage the cycle cancels and informs the operator to repackage and restart sterilizer. If 300 mTorr is not reached within 20 minutes, the system aborts the process and restarts automatically. If the sterilizer restarts automatically and the cycle cancels again for the same error, the abort cycle occurs.

### Injection Stage

| Duration | Parameter | Limit |
|---|---|---|
| 6 Minutes | Pressure | 300 mTorr min. at 10 sec Injection system interrupted P60 = pressure at 60 sec (2 * P60 - P56 - P64 60 MVP aborts)<br>6 Torr min. at end<br>12 Torr max. throughout period |
| | Temperature | 60° C Alarm<br>40 - 50° C Control |

When the chamber pressure has been reduced to 300 mTorr, a premeasured amount of concentrated H2O2 is injected from the cassette into the vaporizer cap and vaporized. If the pressure in the chamber does not rise above 6 Torr within 6 minutes, the cycle is canceled and the message “Low Pressure In Injection” is printed. If the pressure in the process chamber has risen to between 6 and 12 Torr at the end of the 6 minute injection stage, the diffusion phase begins.

### Diffusion Stage

| Duration | Parameter | Limit |
|---|---|---|
| 42 Minutes | Pressure | 6 Torr min. |
| | | 14 Torr max. |

As the vaporized H2O2 diffuses over the surfaces of the objects to be sterilized, the chamber pressure normally rises between 6 to 14 Torr. If the chamber pressure rises higher than 14 Torr during this phase, too much air may have leaked into the process chamber and the cycle is canceled with the message “Over Pressure In Diffusion.” If the chamber pressure drops below 6 Torr, some absorptive material may be in the load and the cycle is canceled with the message “Low Pressure in Diffusion.”

### Diffusion Pump-Down

| Duration | Parameter | Limit |
|---|---|---|
| 2 Minutes | Pressure | 500 mTorr or greater |

If the chamber pressure has stayed within the limits, the last 2 minutes of the diffusion stage are used to evacuate enough of the vapor from the chamber to establish the 500 mTorr pressure for the plasma stage. The vacuum pump is turned on and the throttle valve is opened until the 500 mTorr threshold is reached. The process controller then modulates the throttle valve position to maintain 500 ±25 mTorr. This phase is completed at two minutes regardless of the chamber pressure.

### Plasma Stage

| Duration | Parameter | Limit |
|---|---|---|
| 3 Minutes | Time | Maximum pump down time to reach 525 mTorr |
| 15 Minutes | Time | Plasma stage with RF turned ON |
| 5 Minutes | | Debounce for initial pressure surge<br>1 min. debounce after 5 minutes debounce |
| | Delivered power | 365 Watts min.<br>400 Watts nominal |
| | Pressure | 525 mTorr max.<br>475 mTorr min.0 |

If the pressure in the chamber has not reached the 500 mTorr threshold when the plasma stage begins, an additional 3 minutes is allowed to reach 500 mTorr. If the pressure still has not reached 500 mTorr at the end of that period, the cycle is canceled with the message “Vacuum Insufficient for Plasma.”

When the pressure has reached 500 mTorr, radio frequency (RF) energy is radiated within the process chamber for 15 minutes. This RF energy results in the formation of a plasma from the hydrogen peroxide. In the plasma state, the hydrogen peroxide vapor breaks apart into reactive species that include free radicals.

The combined use of hydrogen peroxide vapor and plasma, safely and rapidly sterilizes most medical instruments and materials without leaving toxic residues.

If the pressure exceeds the set limits, the cycle is canceled with the message “Pressure Out of Range.”

The RF power is delivered to the chamber at 400 +25 -35 Watts. If the RF Power is not within the set limits, the cycle is canceled with one of the messages “RF Amplifier Failure,” “Plasma Not Lit,” and “Low Plasma Power.”

### Vent Stage

At the end of the Plasma Stage, the RF energy is turned off and the process chamber is vented to the atmosphere through a bacteriological (HEPA) filter. The chamber is pumped down again to 1 Torr and then again vented to the atmosphere.

At the end of the second vent stage, which is the end of the sterilization cycle, an audible alarm tells the operator that the door may be opened and the sterilized contents removed from the process chamber. The printer prints a summary of cycle parameters, and the LCD displays “Process Complete.”

### First Vent

| Duration | Parameter | Limit |
|---|---|---|
| Variable | Pressure switch | ~690 Torr |

### Pump Down

| Duration | Parameter | Limit |
|---|---|---|
| Variable | Pressure | 1 Torr |

### Final Vent

| Duration | Parameter | Limit |
|---|---|---|
| Variable | Pressure switch | ~690 Torr |

# Canceled Cycles

If the process parameters are not met in any of the stages, or if the operator presses CANCEL, a controlled shutdown is performed while descriptive messages are displayed and printed.

If a cycle is canceled for the first time because the vacuum was not low enough for injection; or the door temperature did not reach 40° C; or there was no pressure rise in injection; or there was a power failure longer than 1 minute; or the injection system was interrupted; the following occurs:

- The chamber is vented to atmospheric pressure.
- The cassette is indexed if injection system interrupted was detected.
- The cycle is automatically restarted without opening the door.
- The sterilizer restart message and other appropriate messages at end of restarted process are printed.
- If a cycle is canceled for any of the reasons listed above for a second consecutive time or for any other failure, the controller goes through a 10 minute process as follows:
- The alarm sounds for 10 seconds.
- The alarm light comes on until the cycle ends.
- The chamber is evacuated to 500 mTorr.
- RF power is turned ON, the chamber continues to evacuate until 200 mTorr is reached (or until 10 minutes has elapsed).
- RF power and vacuum pump are turned OFF.
- Vent valve is opened.
- When the vacuum switch senses atmospheric pressure in the chamber, the vent valve is closed and the chamber starts evacuating for a second time.
- At 500 mTorr RF power is turned ON for the second time.
- The chamber continues evacuating. At the completion of 10 minutes total elapsed time in the cancel cycle; the RF power and the vacuum pump are turned OFF; the chamber is vented to atmosphere.
- The alarm is sounded again for 10 seconds.
- The appropriate cancellation message is printed.
- The door opens.

The cycle records are printed out showing the reason the system performed a restart or cancel sequence. The data from the correctly completed stages is printed in black along with the canceled cycle information and recommended operator reaction in red.

# Alarm Limits By Parameter

Time is controlled by a 4 MHz crystal (6 MHz on Block 2) located on the CPU card.

| Control/ Monitor | Alarm Limits | Process Equipment Specification |
|---|---|---|
| M | 20 min. | Vacuum phase maximum time |
| C | 0 - 5 min. | Preheat vaporizer first 5 mins. in Vacuum stage |
| C | 5 - 20 min. max. | Preheat vaporizer during Vacuum stage at 60% ON - 40% OFF duty cycle until Injection |
| C | 10 min. | Vaporizer heater ON during Injection and Diffusion stage |
| C | 50 min. | Diffusion period (2 min. pump down) |
| M | 5 min. | Plasma pump-down (2 - Diff |
| M | 2 min. | Plasma light-off alarm |
| M | 5 min. | Pressure recovery time after turning on Plasma (RF) |
| M | 1 min. | Pressure out of range |
| M | 15 min. | Plasma on period |
| M | 8 min. | Vent stage maximum time |
| M | 100 min. | Process time-out |
| M | 15 sec | Cassette acceptance time-out |

| | | |
|---|---|---|
| M | 500 msec | Cassette advance (starts reading bar-code) |
| M | 10 min. | Cassette to clear chute switch |
| M | 10 sec | Chute switch closure to reset cassette counter |
| C | 400 msec | Injector pump pawl lift |
| M | 15 sec | Eject cassette time-out |
| M | 1 min. | Close throttle valve (time-out) |
| M | 15 sec | Door to close |
| M | 15 sec | Door to open |
| M | 2 min. | Printer fault |

## *Pressure*

A capacitance manometer, mounted on the top of chamber with a connection tube oriented 30° from vertical, monitors pressure within the chamber.

| Control/ Monitor | Alarm Limits | Process Equipment Specification |
|---|---|---|
| M | 300 mTorr | Minimum injection pressure threshold (10 sec) |
| M | < mV | Injection System Interrupted detection algorithm (2 * P60 - P56 - P64 60 mV for good injection) |
| M | 6 Torr | Low injection pressure alarm (6-20 min.) |
| M | 12 Torr | Upper injection pressure alarm ( min.) |
| M | 6 Torr | Low diffusion pressure alarm (20-48 min.) |
| M | 14 Torr | Upper diffusion pressure alarm (6 min.) |

| | | |
|---|---|---|
| M | 750 mTorr | Max. pressure rise in 10 min. (38-48 min.) |
| C | 525 mTorr | Plasma high pressure alarm |
| C | 475 mTorr | Plasma low pressure alarm |
| C | 690 Torr | Vent (atmospheric pressure switch) |
| C | 1 Torr | Vent pump-down threshold |

### *RF Delivered Power*

Directional coupler in RF amplifier board.

| Control/ Monitor | Alarm Limits | Process Equipment Specification |
|---|---|---|
| M | 2.92 Volts | Minimum allowable power (365 W) |

### *Temperature*

Thermistors are located on the chamber and door to monitor temperature.

| Control/ Monitor | Alarm Limits | Process Equipment Specification |
|---|---|---|
| C | 40°C | Lower limit |
| C | 50°C | Upper limit |
| M | 60°C | Temperature alarm threshold |

# Software Overview

Software controls the STERRAD® 100 Sterilizer to ensure the most efficient sterilization process as well as ease of use and operator safety. The software manages the sterilization process throughout the five stages: vacuum, injection, diffusion, plasma, and vent. The software also monitors pressure, temperature, and other factors to determine when to move from one stage to another, what to adjust in the various stages, and when to abort the process if there are problems. The software controls the machine in the monitor state including the processing of hydrogen peroxide cassettes.

## Program Structure

The software is divided into three program elements (main control, editor, and process).

The Main module accomplishes the following tasks:·

- Digital I/O read and write.
- Determine mode (edit or process).
- Cassette management.
- LCD display.
- Chamber door control.
- Temperature control

The Edit module controls the update of the system date and time as well as the serial number, total machine cycles, and the preventative maintenance screen. It uses parts of the main program (such as digital I/O) to perform some of its tasks.

The Process module monitors the sterilization process as it occurs and calls each of the stages in turn:

- Vacuum
- Injection
- Diffusion
- Plasma
- Vent
- Abort cycle

All of these modules, including the abort cycle, use parts of the main program to perform their tasks.

## Input Data

Three types of input data are accepted by the software. Analog inputs (temperature, pressure, and RF power) are converted to digital readings and interpreted by the software. Operator inputs (inserting cassettes and pressing pressure switches) are read as digital inputs. All other sensors used as inputs to the system are digital.

Digital and analog inputs are used to monitor all phases of the process, just as digital outputs control the process.

## Output Data

Outputs to the operator include LCD messages, printed messages, control panel lights, audible beeps, and the opened or closed door.

Digital outputs to the machine's hardware components are used in every stage of the sterilization process to perform tasks such as opening and closing the throttle valve, controlling the RF power, and communicating with the printer.

## 100 Millisecond Interrupt

The software runs a 100 millisecond interrupt as its highest priority interrupt. If the "heartbeat timer" interrupts any segment of the software, other than the monitor state, the software goes to cancel/abort processing and provides a controlled failure rather than system lockup.

## 10 Millisecond Interrupt

In three cases 100 milliseconds is too long for the system to wait between cycles. For these three areas the software uses a 10 millisecond interrupt as an interrupt for faster processing:

- the throttle valve controller
- the bar code reading
- cassette positioning mark detector

## Software Safety Considerations

The software is designed to shut down certain functions for safety reasons. These functions are listed below.

- The output of the RF generator shuts down when faced with mismatches of greater than 1.5 VSWR to protect personnel from the RF shock.
- The door over center sensor is monitored to protect personnel from hazards.
- The active low digital output design forces a graceful shut down in the event of failure in any device or harness.
- The door remains closed if a power failure occurs during a running cycle.
- The door automatically reverses if there is an obstruction of 14 kg (30 lbs) or more.
- The RF power can not be activated if the chamber pressure is over 700 mTorr.
- If a failure occurs, a 10 minute **CANCEL CYCLE** runs to prevent exposure of the operator to $H_2O_2$ vapor.

| Process Parameter | Tolerance |
|---|---|
| Time | ± 1 sec |
| Pressure | ± 25 mTorr |
| Temperature | ± 2.5 Celsius |

# User Interface and Operator Controls

The operator controls are located on the control panel at the front top right of the sterilizer and include the following push button controls:

- **START** -Initiate a cycle after automatically closing the door, if necessary. At the end of a successful cycle, the door remains closed.
- **CANCEL** - Stops the cycle and opens the door at the end of the CANCEL operation.
- **OPEN DOOR** - Opens the door when the machine is in idle mode.
- **CLOSE DOOR** - Closes the door.
- **PAPER ADVANCE** - Advances the printer paper while the switch is pressed.

## *Edit Mode*

The date, time, PM, clock mode, reset, serial number, and total machine cycles can be set using the Edit mode.

# Functional Subsystems

For purposes of description, different parts and subassemblies within the sterilizer are defined as subsystems. The Vacuum, Process Chamber, Door, Injection, Disposable Cassette, Pneumatic, Control, Radio Frequency, User Interface, and AC Interface are all subsystems of the STERRAD® 100 Sterilizer.

Each fabricated part is indelibly marked with the ASP part number and revision. A visible, major component of each service module is marked with the assembly part number and revision level. Major subassemblies also bear a serial number.

# Additional Documentation

There is an additional STERRAD® 100 Sterilizer manual designed for use by the operator. It provides day-to-day operational information and safety procedures. It is not necessary to possess this manual to perform the required service for the STERRAD® 100 Sterilizer. However, you may find it helpful. The items below are available from Customer Service.

- LC-10100-M01 STERRAD® 100 Sterilization System Operator's Manual - English
- 90-04679-0-001 STERRAD 100 Sterilization System Feedthrough Removal and Replacement Service Video
- 90-04680-0-001 STERRAD 100 Sterilization System Door Removal and Replacement Service Video

The videos are also available in PAL and SECAM formats.

## *Service Guide Changes*

Changes to procedures that occur between updates are usually communicated by Service Technical or TSNews Bulletins.

# STERRAD 100 S Theory of Operation

## Introduction

The STERRAD® 100 S Sterilizer is a hydrogen peroxide gas plasma sterilizer that provides an environment sufficiently lethal to microorganisms to produce at least a 10-6 Sterility Assurance Level (SAL) for devices within label claims,. The STERRAD 100 S Sterilizer has two separate peroxide injections/plasma stages, rather than one, in the sterilization cycle.

The STERRAD 100 S Sterilizer process has four distinct phases

- Phase 1 Vacuum. This is a preconditioning stage with air plasma.
- Phase 2. Sterilization A. Injection, diffusion , plasma stages.
- Phase 3. Sterilization B. Injection, diffusion, plasma stages.
- Phase 4. Venting. A final venting to return chamber to atmospheric pressure.

This multiphased cycle reliably process sterile medical devices without toxic residues. The devices are then safe for immediate use or suitable for storage and later use. The equipment has built-in safeguards to ensure completion of each cycle run through all it phases.

## Phase 1 - Vacuum Preconditioning

### *Step One*

The vacuum stage is the first stage of the sterilization process. The chamber pressure is pumped down to 700 mTorr then plasma is lit.

### *Step Two*

The plasma stays lit at a controlled pressure of 500 mTorr for the 10 minutes for the short cycle or 15 minutes for the long cycle. This conditions the load for later sterilization. This air plasma is to assist in removing any residual moisture on or in the load by accelerating the vaporization of the water and allowing it to be removed from the chamber by the vacuum pump. The vent valve is opened following the plasma condition. Finally the chamber pressure is pumped down to 400 mTorr before transitioning to the injection stage.

### *Step Three*

At the end of the 15 minutes, the chamber is vented to atmospheric pressure with filtered air.

### *Step Four*

After the chamber reaches atmospheric pressure, there is a reduction of pressure in the chamber from 760 Torr (atmospheric pressure) to 0.4 Torr through the use of a vacuum pump.

## Phase 2 - Sterilization A

### *Step One*

When the chamber has reached the pressure of 0.4 Torr, or less, approximately 1800 ml of a 59% nominal solution of hydrogen peroxide is injected into the sterilization chamber. The injection is accomplished by injector needles puncturing a hydrogen peroxide-containing ampoule in a cassette. Each cassette contains enough ampoules for five complete sterilization cycles. The positioning of the cassette and the injection is automated and software-monitored to ensure injection takes place. This step lasts 6 minutes.

### *Step Two*

At the end of the 6 minutes, the chamber is vented to atmospheric pressure with filtered air and held for 2 minutes (short cycle) or 10 minutes (long cycle). Adding filtered air to the chamber further compress the hydrogen peroxide, driving it into the lumens and other intricate mechanisms found in or on many medical devices.

### *Step Three*

After the chamber has been held at atmospheric pressure for two minutes, there is a reduction of pressure in the chamber from 760 Torr (atmospheric pressure) to 0.5 Torr through the use of vacuum pump.

### *Step Four*

During the plasma step of the cycle, RF energy applied for two minutes across the electrodes produces a series of reactions in the low pressure hydrogen peroxide vapor in the chamber. This leads to the generation and acceleration of charged particles and the generation of free radicals and other reactive chemical species. This action enhances decomposition of hydrogen peroxide which has been added to the chamber.

### *Step Five*

At the conclusion of the plasma stage, pressure is reduced in the chamber from 0.5 Torr to 0.4 Torr through the use of a vacuum pump.

## Phase 3 - Sterilization B

This is a repeat of the Sterilization A phase, excluding the final step.

### *Step One*

When the chamber has reached the pressure of 0.4 Torr, or less, approximately 1800 ml of a 59% nominal solution of hydrogen peroxide is injected into the sterilization chamber. The injection is accomplished by injector needles puncturing a hydrogen peroxide-containing ampoule in a cassette. Each cassette contains enough ampoules for five complete sterilization cycles. The positioning of the cassette and the injection is automated and software-monitored to ensure injection takes place. This step lasts 6 minutes.

### *Step Two*

At the end of the 6 minutes, the chamber is vented to atmospheric pressure with filtered air and held for 2 minutes (short cycle) or 10 minutes (long cycle). Adding filtered air to the chamber further compresses the hydrogen peroxide, driving it into the lumens and other intricate mechanisms found in or on many medical devices.

### *Step Three*

After the chamber has been held at atmospheric pressure for two minutes, there is a reduction of pressure in the chamber from 760 Torr (atmospheric pressure ) to 0.5 Torr through the use of a vacuum pump.

### *Step Four*

During the plasma step of the cycle, RF energy applied for two minutes across the electrodes produces a series of reactions in the low pressure hydrogen peroxide vapor in the chamber. This leads to the generation and acceleration of charged particles and the generation of free radicals and other reactive chemical species. This action enhances decomposition of hydrogen peroxide which has been added to the chamber.

# Phase 4 - Venting

## *Step One*

At the conclusion of the plasma step, the chamber pressure is returned to atmospheric pressure by venting with filtered air. This concludes the process and the instruments are ready to be removed for use or for storage.

# STERRAD 100 S Process Times

The STERRAD® 100 S Sterilization System process takes 51-72 minutes (depending on the cycle chosen) and uses 1440 µl of 59% $H_2O_2$ (nominal is 1800). The table below presents the process as a series of steps showing the cycle parameters, pressures and time. Other sections of this guide present additional information on sterilizer operation. The process curves are graphical representations of the sterilization cycle.

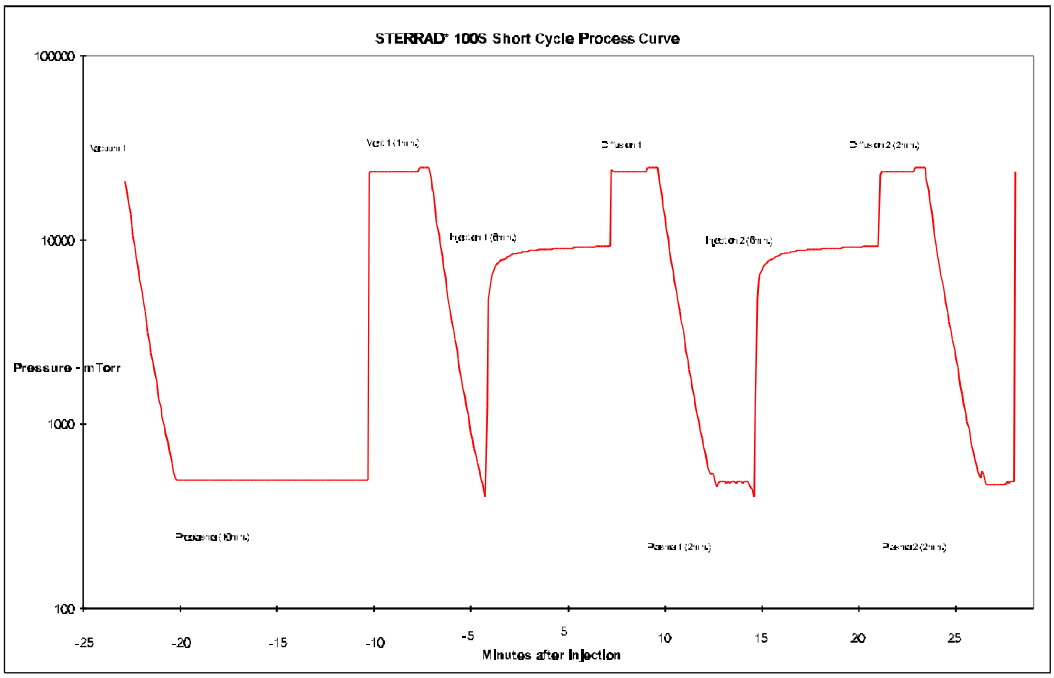


***Figure 2-2. Short Cycle Process Curve***

✔ *Note: Times listed are for an empty chamber cycle. With a loaded chamber vacuum to 700 mTorr may be up to 9 minutes before cancellation.*

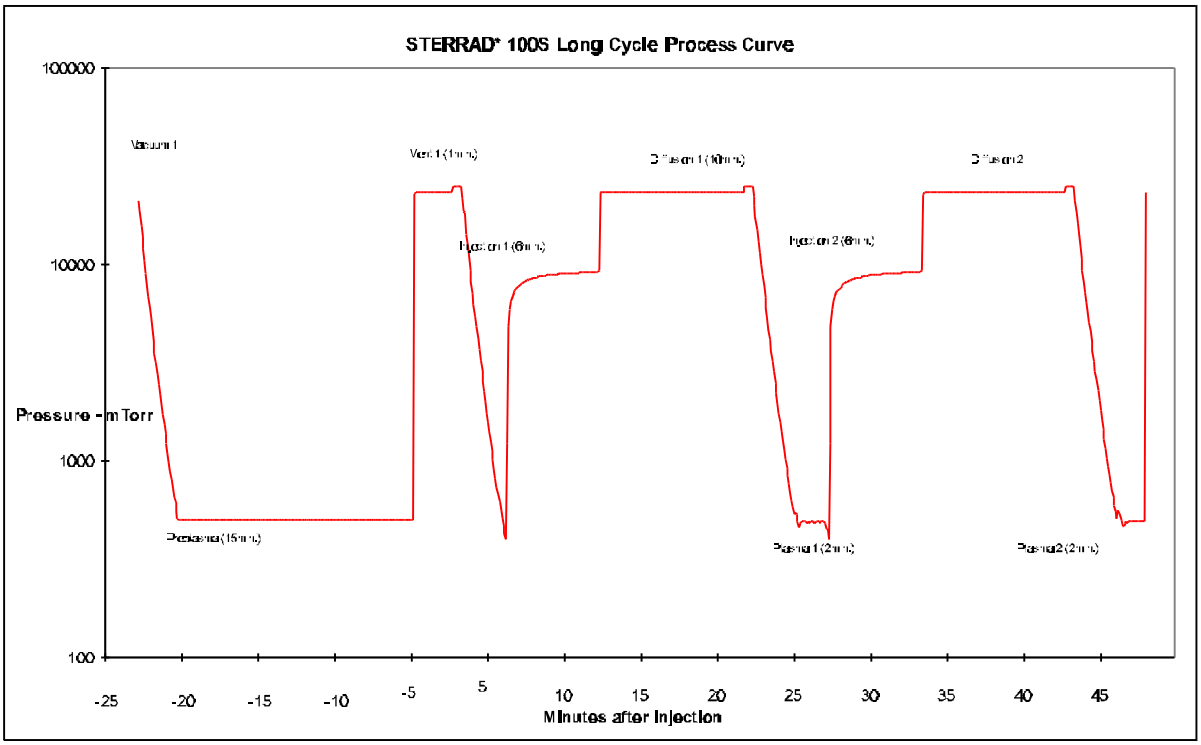


***Figure 2-3. Long Cycle Process Curve***

| Step | Cycle Parameters | Short Cycle Time | Long Cycle Time |
|---|---|---|---|
| 1 | Vacuum to 700 mTorr | 5 minutes (approx) | 5 minutes (approx) |
| 2 | Pre-Plasma at 800 mTorr | 10 minutes | 15 minutes |
| 3 | Vent to 760 Torr | 1 minute | 1 minute |
| 4 | Vacuum to 400 mTorr | 5 minutes (approx) | 5 minutes (approx) |
| 5 | Injection 1 at 400 mTorr | 6 minutes | 6 minutes |
| 6 | Diffusion 1 at 760 Torr | 2 minutes | 10 minutes |
| 7 | Vacuum to 500 mTorr | 5 minutes (approx) | 5 minutes (approx) |
| 8 | Plasma at 500 mTorr | 2 minutes | 2 minutes |
| 9 | Vacuum to 400 mTorr | 0.1 minute | 0.1 minute |
| 10 | Injection 2 at 400 mTorr | 6 minutes | 6 minutes |
| 11 | Diffusion 2 at 760 Torr | 2 minutes | 10 minutes |
| 12 | Vacuum to 500 mTorr | 5 minutes (approx) | 5 minutes (approx) |
| 13 | Plasma at 500 mTorr | 2 minutes | 2 minutes |
| 14 | Vent to 760 Torr | 0.3 minute | 0.3 minute |
| | **TOTAL TIME (approximate)** | **51 minutes** | **72 minutes** |

# Chapter 3

# System Messages

## Contents

Introduction . . . . . 3-2
Using System Messages . . . . . 3-2

# Introduction

The STERRAD® 100 Sterilizer and the STERRAD **100 S** Sterilizer have many similar messages. However, because of the differences in cycle parameters, the STERRAD 100 S system has a number of messages that are unique to its functions.

The messages are listed here in alphabetical order. Many of the messages are preceded by an LED display "Cycle Canceled Please Wait" or "Cycle Canceled Please Wait . . . 10 Min." Those displays are not shown here because they are so common. Instead the written messages associated with the "Cycle Canceled" messages are reproduced here. Messages in all capital letters are those displayed on the LED. If there is also a written message, it is shown below the displayed message. Messages in upper and lower case letters are usually written messages accompanying the Cycle Canceled display.

# Using System Messages

Messages with ☑ next to them are exclusive to STERRAD 100 S systems.

**IMPORTANT!:** Your first step when troubleshooting a system is to verify that the system is **properly connected to the power source**, and to make sure all the **subsystems are properly connected to the AC** system and all circuit breakers are on and functioning normally. Once you have verified these things, proceed with your troubleshooting steps.

Be sure to check the topics at the end of the message list. These topics contain conditions that may not generate an error message but result in other obvious problems.

## XXX Cycles, remove cassette box

### Problem/Condition

The maximum number of cassettes have been captured in the cassette collection box.

### Action

The box is full. Remove it and replace it with a new one.

# CASSETTE INSERTED INCORRECTLY

There is no printed message for this condition.

### Problem/Condition

The bar-code cannot be read. The cassette ejects.

### Action

- ✦ Insert a new cassette making sure it is inserted in the correct orientation.
- ✦ If the problem persists, inspect the cassette, check the injector pump optics.
- ✦ Repair and recalibrate if necessary.

# Cassette is Not Accepted

### Problem/Condition

System appears to be operating normally following adjustment or PM, however when trying to run a cycle, the unit does not accept the cassette.

### Action

- ✦ If you have been servicing the injector valve you may have failed to replace the pneumatic tubing. Reconnect it to the injector pump.
- ✦ Perform cassette optics test.

# CASSETTE OUT-OF-DATE

There is no printed message for this condition.

### Problem/Condition

This cassette has expired or the sterilizer system date is incorrect.

### Action

- ✦ The cassette automatically exits to the collector box. Insert a new cassette.
- ✦ Check system date—pay particular attention to the year. Reset if incorrect.

## CLOSE DOOR TIME-OUT CALL TECHNICAL SERVICE

There is no printed message for this condition.

### Problem/Condition

More than 15 seconds passed before the door top sensor was activated.

### Action

- Check the door top sensor and speed control valve
- Verify pneumatic pressure. Observe gauge (60 to 80 PSI)

## Control Panel is Blank

### Problem/Condition

5 VDC power supply checks low at 4.68 VDC; analog VDC is low at approximately 1.880. Equipment running fine otherwise. During adjustment of 5 VDC power supply equipment shuts down at 4.80 VDC.

### Action

- Check contrast.
- Attempt to enter and then exit the Edit mode.
- Check voltages.
- Perform a Master Reset.
- Start cycle, cancel it and recheck the voltages.
- Replace the 5 V power supply.
- Replace the control enclosure.

## CYCLE 1 SHORT CYCLE YES(START)—NO(CANCEL)

- If you are not processing a flexible scope, press **START** to start a short cycle.
- If you are processing a flexible scope, press **CANCEL** to go to the **CYCLE 2** (long cycle) option.

## CYCLE 2 LONG CYCLE YES(START)—NO(CANCEL)

- If you are processing a flexible scope, press **START** to start a long cycle.
- If you are not processing a flexible scope, press **CANCEL** to go to the **CYCLE 1 (**short cycle option.

# Door Going Up and Down

### Problem/Condition

Equipment has been serviced and now door doesn't work.

### Action

- Check connector on top of optics board. It may have been knocked loose during servicing.
- Check for foreign objects under the counterweight.
- Check door sensors.
- Perform door test.

# Door Stuck in Closed Position

### Problem/Condition

Door sensors pass tests but door cannot be opened by either throwing the circuit breaker or using AutoTest. Door solenoid light is lit (red). Pressure gauge is in range (60-80 PSI) and compressor is operational. There is NO vacuum in the chamber.

### Action

- Take the pneumatic door cylinder pressure hoses and switch them. (One hose blows air.) Door should open but cannot now be closed.
- Replace door pneumatics solenoid.
- Check vacuum switch.

# DOOR IS BEING BLOCKED

There is no printed message for this condition.

**Problem/Condition**

Something may be blocking the door or the over-center sensor was activated before the top sensor.

**Action**

Check the door top sensor, the over center sensor, the door position, the over center flag and the harness connection.

# DOOR WILL CLOSE AUTOMATICALLY

There is no printed message for this condition.

**Problem/Condition**

Indication that the door will close normally because **START** has been pressed.

**Action**

No action needed.

# EJECT TIME OUT CALL TECHNICAL SERVICE

There is no printed message for this condition.

**Problem/Condition**

Cassette ejection is greater than 20 seconds or cassette capture is more than 30 seconds.

**Action**

- A cassette is stuck in the injector pump. Remove it.
- Check injector pump optics
- Check injector pump pneumatic solenoid.

# INCORRECT CASSETTE TYPE

There is no printed message for this condition.

### Problem/Condition

- The inserted cassette is not the correct type for the STERRAD® 100 Sterilizer.
- The inserted cassette is not the correct type for the STERRAD **100 S** Sterilizer.

### Action

- Insert a STERRAD 100 Cassette.
- Insert a STERRAD **100 S** Cassette

## INDEX CASSETTE FAILURE CALL TECHNICAL SERVICE

There is no printed message for this condition.

### Problem/Condition

The system failed to detect the cassette. The cassette is ejected into the collector box.

### Action

- Inspect the cassette, the pump optics and electronics.
- Perform cassette sensor test.
- Remove and replace injector pump.
- Check the floating guides

## Injection system interrupted. Repackage load. Restart sterilizer. Insert new cassette.

### Problem/Condition

The sterilization process canceled because the cassette was faulty.

### Action

The faulty cassette ejects into the collection box.

- ✦ Insert a new cassette.
- ✦ Repackage the load.
- ✦ Restart the sterilizer.

## Injector heater failure. Call ASP Technical Service.

### Problem/Condition

The current sensor has not detected activation of the vaporizer heater.

### Action

- ✦ Check the vaporizer heater.
- ✦ Inspect the injector valve and replace if necessary.
- ✦ Replace the current sensor.

# Injection system interrupted.

**Problem/Condition**

Bad cell in cassette.

**Action**

Check the customer log to determine if there is an ongoing problem in this area.

# Injection System Interrupted See Op Manual Appendix A

**Problem/Condition**

The sterilization process canceled because the cassette was faulty.

**Action**

- The faulty cassette ejects into the collection box.
- Insert a new cassette.
- Repackage the load.
- Restart the sterilizer.

# INSERT NEW CASSETTE

There is no printed message for this condition.

**Problem/Condition**

There is no cassette in the machine.

**Action**

Insert a new cassette.

## INSERT NEW CASSETTE CALL TECHNICAL SERVICE

There is no printed message for this condition.

**Problem/Condition**

- The Level 1 PM is past due.

or

- The Level 2 PM is past due.

**Action**

- Perform a Level 1 PM
- Perform a Level 2 PM.

## INSERT NEW CASSETTE NO MORE CYCLES CAN BE RUN

**Problem/Condition**

No cassette is in the machine.

**Action**

Insert a new cassette

## INSERT NEW CASSETTE MAINTENANCE DUE

There are two possible printed messages

- PM interval due L1.
- PM interval due L2.

# Low Pressure In Diffusion Call ASP Technical Service

## Problem/Condition

The system did not reach atmospheric pressure by the end of the diffusion stage.

or

For the second consecutive cycle, diffusion pressure is under 6 Torr. There is insufficient H2O2 for diffusion or it is being absorbed by the load.

## Action

- Check the vacuum switch
- Check the vent valve replace if necessary.
- Run an empty chamber cycle.
- Check the door and chamber temperatures.
- Test the injector valve function.
- Test the pneumatics system.

# Low pressure in diffusion. Repackage load. Restart sterilizer.

## Problem/Condition

Diffusion pressure is under 6 Torr. There is insufficient H2O2 for diffusion or it is being absorbed by the load.

## Action

- Check for absorbent materials in the load.
- Repackage the load.
- Check the cassette.
- Restart the sterilizer.

# Low pressure in injection.

## Problem/Condition

Possible bad cell in cassette or partially clogged vaporizer cap.

## Action

Check customer log to determine if there is an ongoing problem in this area. Additional customer training may be necessary.

# Low pressure in injection. Call ASP Technical Service.

## Problem/Condition

- For the second consecutive cycle, the pressure did not rise above 6 Torr at the end of the injection stage.
- After adjustments the highest reading obtainable is approximately 5.35 Torr.

## Action

- Clean the vaporizer plate.
- Clean the injector valve vaporizer bowl or cap.
- Run an empty chamber cycle. Injection pressure must be above 8.5 Torr.
- Check for peroxide running down the sides of the injector valve and interfering with heater contact.
- Make sure the heater is plugged in and voltage is 24 VAC.
- Inspect the injection subsystem for malfunction including possible dissolved outer coating due to excessive hydrogen peroxide contact.
- Replace the injector valve.

# Low pressure in injection. Repackage load. Restart sterilizer.

## Problem/Condition

Pressure did not rise above 6 Torr at the end of the injection stage.

## Action

- Inspect the load for linen or cellulose items.
- Repackage the load.
- Restart the sterilizer.
- If this is the first load after a period of inactivity, check the temperature.
- Replace the injector pump if necessary.

# Low Pressure In Injection See Op Manual Appendix A

## Problem/Condition

The pressure did not rise above 6 Torr by the end of the injection stage.

## Action

- Run an empty chamber cycle. Injection pressure must be above 8.5 Torr. If so the problem is with the load. Repackage and restart the sterilizer.

If problem persists, do the following:

- Verity that the cassette is unused and undamaged.
- Verify that the throttle valve is closing completely prior to injection.
- Clean the vaporizer plate and vaporizer bowl.
- Check for peroxide running down the sides of the injector valve and interfering with heater contact.
- Make sure heater is plugged in and voltage is 24 VAC
- Inspect the injection subsystem for malfunction including possible dissolved outer coating due to excessive hydrogen peroxide contact.
- Replace injector valve

## Low plasma power. Repackage load. Restart sterilizer.

### Problem/Condition

After 2 minutes, RF delivered power is less than 365 W but greater than 200 W.

### Action

- Ensure the shelves are not in contact with the chamber or the door.
- Make sure the load is not in contact with the electrode.
- Repackage the load.
- Restart the sterilizer.

## Low RF Power in Vacuum. Call ASP Technical Service

### Problem/Condition

RF delivered power is less than 365 W but greater than 200 W.

### Action

- Remove the shelves and run an empty chamber cycle. If completed correctly, reinstall the shelves.
- Check the RF subsystem

## Low RF Power. Call ASP Technical Service

### Problem/Condition

RF delivered power is less than 365 W but greater than 200 W.

### Action

- Remove the shelves and run an empty chamber cycle. If completed correctly, reinstall the shelves.
- Check the RF subsystem for malfunction.

# Low plasma power. Call ASP Technical Service.

**Problem/Condition**

RF delivered power is less than 365 W but greater than 200 W.

**Action**

- Remove the shelves and run an empty chamber cycle. If completed correctly, reinstall the shelves.
- Check the RF subsystem for malfunction.

# Moisture in load. Dry and repackage load. Restart sterilizer.

**Problem/Condition**

Pressure rises of 50 mTorr or more during pump down in the vacuum phase in the pressure range of approximately 4 Torr to 1 Torr are indicative of water freezing.

**Action**

- Handle the load with gloves as H2O2 may be present.
- Dry load.
- Repackage the load.
- Restart the sterilizer.

# NO CASSETTE PRESS=XXX.XX MIN

There is no printed message for this condition.

**Problem/Condition**

No cassette was loaded at the start of the cycle or an unacceptable cassette was inserted during the cycle.

**Action**

Insert a new cassette.

# No cassette in sterilizer. Repackage load. Restart sterilizer.

## Problem/Condition

- The sterilization process canceled because there is no cassette in the sterilizer.
- Cycle was started or restarted without a cassette.
- Injection was interrupted at the 10th cell of the cassette.

## Action

- Insert a new cassette.
- Repackage the load.
- Restart the sterilizer.

# NO DISPLAY

Software anomaly SP = XXXXX Call ASP Technical Service

## Problem/Condition

There is a software error. The printed message contains the memory address of the error.

## Action

- Test the controller.
- Check the power supplies .
- Replace the software.

# No RF Power in Vacuum. Call ASP Technical Service

## Problem/Condition

RF delivered power is less than 100 W.

## Action

- Check the load and make sure it is not in contact with the electrode.
- Check the shelves and make sure they are not in contact with the door, or the chamber.
- Check the RF power and replace if necessary.
- Replace the RF amplifier
- Replace the RF match.
- Replace the electrode
- Replace the microprocessor board.

# No RF Power. Call ASP Technical Service

## Problem/Condition

RF delivered power is less than 100 W.

## Action

- Check the load and make sure it is not in contact with the electrode.
- Check the shelves and make sure they are not in contact with the door, or the chamber.
- Check the RF power and replace if necessary.
- Replace the RF amplifier
- Replace the RF match.
- Replace the electrode
- Replace the microprocessor board.

# OPEN DOOR TIME-OUT. CALL TECHNICAL SERVICE.

There is no printed message for this condition.

## Problem/Condition

More than 15 seconds has passed since clearing the top sensor and the door has not opened.

## Action

- Test the door bottom sensor, the speed control, the air valves and the vacuum in the chamber.
- Check the vacuum switch.
- Replace the door bottom sensor.
- Check for loose connections at the pneumatic pump.

# Operator cancellation. Repackage load. Restart sterilizer.

## Problem/Condition

- Operator canceled cycle.

or

- Operator canceled cycle during the first part of the vacuum stage.

## Action

- Repackage the load.
- Restart the sterilizer.

# OVER CENTER TIME-OUT CALL TECHNICAL SERVICE.

There is no printed message for this condition.

**Problem/Condition**

The door reached the top sensor but did not trip the over-center sensor within 15 seconds.

**Action**

- Check the over center sensor.
- Replace the over-center sensor.
- Check injector pump harnesses.

# Over pressure in diffusion. Call ASP Technical Service

**Problem/Condition**

- For the second consecutive cycle, diffusion pressure is over 14 Torr, or;
- During empty chamber cycle a steady rise in chamber pressure is seen in injection stage and then in diffusion stage with sudden shut-down in diffusion. Injection pressure is in range, vacuum stage pressure is good, divide by 2 voltage is good.

**Action**

- Run an empty chamber cycle.
- Examine the chamber and the door seal for any possible leaks.
- Perform a leak back test.
- Replace the analog board if the second problem is seen. This is NOT a leak.
- Replace the capacitance manometer.

# Over pressure in diffusion. Repackage load. Restart sterilizer.

## Problem/Condition

The diffusion pressure is over 14 Torr.

## Action

- Remove any plastic-like materials from the load. They may be out-gassing.
- Repackage the load.
- Restart the sterilizer.

# Over pressure in injection. Call ASP Technical Service.

## Problem/Condition

For the second consecutive cycle, the chamber pressure is above 12 Torr in the injection stage.

## Action

- Replace the cassette.
- Inspect the injection system
- Perform a leak back test.
- If leak back test fails check for leaks.

# Over pressure in injection. Repackage load. Restart sterilizer.

**Problem/Condition**

Chamber pressure is above 12 Torr in the injection stage.

**Action**

- Inspect the load for plastic items that may be out-gassing.
- Replace the cassette.
- Inspect system for leaks
- Repackage the load.
- Restart the sterilizer.

# Over Pressure In Injection See Op Manual Appendix A

**Problem/Condition**

The chamber pressure is above 14 Torr in the injection stage of the STERRAD 100 S System.

**Action**

- Replace cassette.
- Inspect injection system.
- Perform leak back test.
- If leak back test fails check for leaks.

## Plasma not lit. Call ASP Technical Service.

**Problem/Condition**

RF delivered power is less than 200 W but greater than 100 W.

**Action**

- Check shelves and make sure they are not in contact with the electrode or chamber door.
- Check the RF system.

## Please Inspect Load Carefully See Op Manual Appendix A

**Problem/Condition**

Hydrogen peroxide may be present on wet items.

**Action**

- **HANDLE THE LOAD WITH GLOVES** as $H_2O_2$ may be present.
- Dry load.
- Repackage the load.
- Restart the sterilizer.

## PLEASE REMOVE CASSETTE

There is no printed message for this condition.

**Problem/Condition**

A cassette is detected by the reflective sensor, but is not under the roller.

**Action**

- Remove the cassette and reinsert.
- If the message repeats, insert a new cassette.
- Check the injector assembly connections.

- Adjust the injector pump optics.
- Perform the injector test.
- Verify that the injector solenoid is operational by pressing the activation button.
- Realign the chute with the injector pump.
- Replace the injector pump.

## PM Interval due: L1

### Problem/Condition

700-750 cycles have been counted since the last PM. PM 1 is due. Also, there is no cassette in the sterilizer.

### Action

- Insert a cassette to continue the current cycle.
- Perform the Level 1 PM as soon as possible.

## PM Interval due: L2

### Problem/Condition

1450-1499 cycles have been counted since the last PM. PM 2 is due. Also, there is no cassette in the sterilizer.

### Action

- Insert a cassette to continue the current cycle.
- Perform the Level 2 PM as soon as possible.

# POSITIONING CASSETTE

There is no printed message for this condition.

### Problem/Condition

The cassette is being positioned. The reflective sensor did not detect the side cell positioning mark. The cassette advances to the next position.

### Action

- Inspect the cassette for damage or smudges on bar-code.
- Insert a new cassette.
- Test the pump optics and electronics

# Power interrupted.

### Problem/Condition

Possible brief power failure.

### Action

Check customer log to determine if there is an ongoing problem in this area. If this is a chronic problem, site may have chronic power problems that need to be addressed by ASP Technical Services and customer's engineering department.

# Power interrupted. Call ASP Technical Service.

### Problem/Condition

Power was interrupted for the second time and for more than 1 minute.

### Action

- Check incoming power supply. Verify that phase is correct.
- Check for loose connections.
- Replace the AC enclosure

# Power interrupted. Repackage load. Restart sterilizer.

**Problem/Condition**

- The power was interrupted, even momentarily, during injection, during the first 4 minutes in diffusion or plasma stages; or for more than 1 minute during diffusion.
- If power is out for more than one minute during the vacuum stage, the cycle restarts.

**Action**

- Repackage the load.
- Restart the sterilizer.

# Power Interrupted See Op Manual Appendix A

**Problem/Condition**

- Power was interrupted for more than one minute during and pump-down or either diffusion stage.

  or

- Power was interrupted for any length of time during application of plasma or during the injection stage.

**Action**

- Repackage the load and restart the sterilizer.

If the problem persists:

- Check incoming power supply. Verify that phase is correct.
- Check for loose connections.
- Replace enclosure.

# Pressure out of range. Call ASP Technical Service.

## Problem/Condition

- For the second consecutive cycle, pressure did not stabilize within the range of 475 mTorr to 525 mTorr after 5 minutes or was out of range more than 60 seconds.

  or

- Pressure did not stabilize within the range of 475 mTorr to 525 mTorr after 5 minutes or was out of range more than 60 seconds

## Action

- Check the RF system.
- Perform a leak back test
- Test the throttle valve.
- Perform the vacuum RF test and verify that pressure is stable during the test.
- Check the capacitance manometer.
- Replace the throttle valve.

# Pressure out of range. Repackage load. Restart sterilizer.

## Problem/Condition

Pressure did not stabilize within the range of 475 mTorr to 525 mTorr after 5 minutes or was out of range more than 60 seconds.

## Action

- Inspect the load for linen or cellulose items.
- Repackage the load.
- Restart the sterilizer.

# Pressure Out of Range In Vacuum See Op Manual Appendix A

## Problem/Condition

Pressure did not stabilize within the range of 475 mTorr to 525 mTorr after 5 minutes of pre-plasma, or was out of range more than 60 seconds after the pressure stabilized.

## Action

- Check the load for wet or plastic like material that may be out-gassing.
- Repackage the load and restart the sterilizer.

If the problem persists, do the following:

- Check RF system.
- Perform leak back test.
- Test throttle valve.
- Perform vacuum RF test and verify that pressure is stable during the test.
- Check capacitance manometer.
- Replace throttle valve.

# PRINTER BUFFER FULL. CALL TECHNICAL SERVICE.

There is no printed message for this condition.

## Problem/Condition

- The printer buffer has exceeded the maximum allowed value of 23.
- Cycle completed or canceled with no printout.

## Action

Perform a Master Reset.

# PRINTER BUFFER FULL SEE OP MANUAL APPENDIX A

There is no printed message for this condition.

**Problem/Condition**

- The printer buffer has exceeded the maximum allowed size.
- Cycle completed or canceled with no printout.

**Action**

Perform a Master Reset.

# PROCESS COMPLETE

If the process was completed without an auto-restart, the printed message contains all the process parameters. If an auto-restart was performed, and the second cycle was successfully completed, you may see “Auto-restart performed” and one or more of the following informational messages:

*Note: STERRAD 100 S Systems do not have an auto-restart feature.*

## STERRAD 100 S Process Complete Messages

- Vacuum not low enough
- Temperature has not risen.
- Injection system interrupted.
- Low pressure in injection
- Power interrupted.
- PM interval due L1.
- PM interval due L2.

## PROCESS COMPLETE CALL TECHNICAL SERVICE

- Level 1 PM Interval Past Due. Call ASP Technical Service.
- Level 2 PM Interval Past Due. Call ASP Technical Service.

### Problem/Condition

- The Level 1 PM is past due.

  or

- The Level 2 PM is past due.

### Action

- Perform a Level 1 PM
- Perform a Level 2 PM

## Process Time Exceeded. Call ASP Technical Service

### Problem/Condition

- The entire sterilization process exceeded the maximum time parameters.
- The system locks up in the vacuum or injection stages. Alarm light is activated.

### Action

- Check the injector pump optics.
- Check the throttle valve connection
- Test the throttle valve.
- Check the power supplies (5.2 V)
- Replace the microprocessor board.

## STERRAD 100 S Process Complete Messages

Any of the following printed messages can be received along with the PROCESS COMPLETE display. If the process was completed without an auto-restart, the printed message contains all the process parameters. I

- Cycle 1 SHORT CYCLE Scope
- Cycle 2 LONG CYCLE Scope
- PROCESS COMPLETE
  Validated by: _____
  Biological Indicator:_____
  NUMBER OF CYCLES AVAILABLE = X
- CASSETTE EXPIRATION DATE: XX/XX
- INSERT NEW CASSETTE
- PM INTERVAL DUE (L1)
- PM INTERVAL DUE (L2)
- 145 CYCLES, CHANGE COLLECTION BOX
- CHANGE COLLECTION BOX. NO FURTHER CYCLES CAN BE RUN

## READY TO USE

There is no printed message for this condition.

### Problem/Condition

System is ready for a new cycle.

### Action

No action is required.

## READY TO USE CALL TECHNICAL SERVICE

There is no printed message for this condition.

**Problem/Condition**

- The Level 1 PM is past due.

  or

- The Level 2 PM is past due.

**Action**

- Perform a Level 1 PM
- Perform a Level 2 PM

## READY TO USE. MAINTENANCE DUE.

There are several possible additional messages for this condition.

- No printout or PM interval due (L1)
- PM interval due (L2)
- READY TO USE MAINTENANCE DUE (L1)
- READY TO USE MAINTENANCE DUE (L2)

## RECOVERING FROM POWER INTERRUPT PLEASE WAIT

There is no printed message for this condition.

**Problem/Condition**

This message appears for 5 seconds on power-up in all cases except: when the system was idle or following a master reset.

**Action**

No action is required.

# REPLACE COLLECTION BOX. NO MORE CYCLES CAN RUN.

Replace used collection box. No further cycles can be run.

### Problem/Condition

30 cassettes have been captured in the cassette collection box.

### Action

The box is full. Remove it and replace it with a new one.

# REPLACE USED CASSETTE COLLECTION BOX.

There are two possible printed messages for this condition.

- Replace used collection box
- XXX cycles, remove cassette box

## REPLACE USED COLLECTION BOX

### Problem/Condition

A cassette is stuck at the top of the exit chute.

### Action

- **YOU MUST WEAR GLOVES!** Open the door on the right side, and remove the cassette from the chute. Place it in the collection box.

# RF amplifier failure. Call ASP Technical Service.

## Problem/Condition

- RF delivered power is less than 100 W.

***Note**: This message does not appear on the STERRAD 100 S Sterilizer.*

## Action

- Check the load and make sure it is not in contact with the electrode.
- Check the shelves and make sure they are not in contact with the door, or the chamber.
- Check the RF power and replace if necessary.
- Replace the RF amplifier
- Replace the RF match.
- Replace the electrode
- Replace the microprocessor board.

# START OPEN DOOR TIME-OUT. CALL TECHNICAL SERVICE.

There is no printed message for this condition.

## Problem/Condition

More than 15 seconds passed and the top sensor has not cleared.

## Action

Check the door top sensor.

# TEMP SENSOR DISCONNECTED NO MORE CYCLES CAN RUN

**Temperature Sensor Disconnected. Call ASP Technical Service**

## Problem/Condition

The temperature sensor is disconnected or has failed.

## Action

- ✦ Check the temperature sensor and make sure it is connected and operating normally.
- ✦ Check the door heater and thermistor, replace if necessary.

# Temperature has not risen.

## Problem/Condition

The system has been below temperature for more than 90 minutes.

## Action

- ✦ Close the door and allow the unit to warm up for at least an hour.
- ✦ Run an empty chamber cycle.
- ✦ Check door heater and thermistor. If recorded temperature is greater than 40° C, replace the thermistor.

# Temperature has not risen. Call ASP Technical Service.

## Problem/Condition

The temperature of the door is below 40° C and has remained so for more than 1 hour.

## Action

- ✦ Close the door and allow the unit to warm up for at least an hour.
- ✦ Run an empty chamber cycle.
- ✦ Check the door heater and thermistor. If recorded temperature is greater than 40° C, replace the thermistor.

## Temperature over 60 degrees. Call ASP Technical Service.

**Problem/Condition**

The temperature of the door or chamber has risen above 60° C.

**Action**

- Replace the solid state relay board
- Replace the analog board
- Replace the thermistor.

## Temperature over threshold. Call ASP Technical Service

**Problem/Condition**

The temperature of the door or chamber has risen above 60° C.

**Action**

- Replace solid state relay board
- Replace analog board
- Replace thermistor.

## TEMP. OVER THRESHOLD. NO MORE CYCLES CAN RUN

**Temperature Over Threshold. Call ASP Technical Service.**

**Problem/Condition**

The temperature of the door or chamber has risen above the specified limits.

**Action**

- Replace state relay board.
- Replace analog board.
- Replace thermistor.

# TEMP. SENSOR FAILURE. NO MORE CYCLES CAN RUN.

**Temperature sensor failure. Call ASP Technical Service**

## Problem/Condition

Temperature of door or chamber is 0° C.

## Action

- Test the thermistors for possible failure.
- Perform the heater test.
- Verify heater voltages
- Replace thermistor.

# UNABLE TO VERIFY INSERT NEW CASSETTE

There is no printed message for this condition.

## Problem/Condition

The bar-code cannot be read for the second time. (This message follows an unsuccessful cassette verification.)

## Action

- Insert new cassette.
- If the message persists, test the cassette optics.

# Vacuum Insufficient. See Op Manual Appendix A

**Problem/Condition**

The pressure did not reach the value necessary for pre-plasma within 12 minutes. Load may be out-gassing.

**Action**

- Run an empty chamber cycle. If it completes successfully, the problem is in the load.
- Repackage the load and restart the sterilizer.
- If the empty chamber cycle is unsuccessful, perform a leak back test.
- Check vacuum pump and add oil if needed.
- Check PM log and perform PM if needed.
- Replace throttle valve.
- Replace vacuum pump.

# Vacuum Insufficient for Plasma. Call ASP Technical Service.

**Problem/Condition**

For the second consecutive cycle, the vacuum did not reach 525 mTorr in the first 3 minutes of the plasma stage. Load may be out-gassing.

**Action**

- Run an empty chamber cycle. If it completes successfully, the problem is in the load.
- If the empty chamber cycle is unsuccessful, perform a leak back test.
- Check the vacuum pump and add oil if needed
- Check the PM log and perform PM if needed
- Replace the throttle valve
- Replace the vacuum pump
- Replace vent valve.

# Vacuum Insufficient for Plasma. Repackage load. Restart sterilizer.

**Problem/Condition**

Vacuum did not reach 525 mTorr in the first 3 minutes of the plasma stage. Load may be out-gassing.

**Action**

- Check load for plastic items.
- Restart the sterilizer.

# Vacuum not low enough.

**Problem/Condition**

Possible moisture in load.

**Action**

Check the customer log to determine if there is an ongoing problem in this area. Additional customer training may be necessary.

# Vacuum not low enough for injection. Call ASP Technical Service.

**Problem/Condition**

- For the second consecutive cycle, vacuum did not reach 1 Torr within 9 minutes.
- For the second consecutive cycle, vacuum did not reach 300 mTorr after an auto-restart.

**Action**

Run an empty chamber cycle. If the cycle runs successfully, the problem is with the load.

- Repackage the load.
- Restart the sterilizer.

If the cycle does not run successfully, perform the tests below.

- Perform the vacuum/RF test.
- Perform the Baratron zero-shift test.
- Perform leak back test.
- Replace vacuum pump

## Vacuum not low enough for injection. Repackage load. Restart sterilizer.

### Problem/Condition

- Vacuum did not reach 1 Torr within 9 minutes.
- Vacuum did not reach 300 mTorr after an auto-restart.

### Action

- Check for moisture in the load.
- Remove any cloth, paper or foam items from the load.
- Repackage the load.
- Restart the sterilizer.

## Vacuum System Interrupted Call ASP Technical Service

### Problem/Condition

The chamber is still at atmospheric pressure after the first 30 seconds of vacuum.

### Action

- Test the vacuum system
- Check power for proper CBA phase rotation.
- Test the vacuum switch
- Perform vacuum/RF test.

# VACUUM SYSTEM INTERRUPTED. NO MORE CYCLES CAN RUN.

Vacuum system interrupted. Call ASP Technical Service.

### Problem/Condition

The chamber is still at atmospheric pressure after the first 30 seconds of vacuum.

### Action

- Test the vacuum system
- Check power for proper CBA phase rotation.
- Test the vacuum switch
- Perform vacuum/RF test.

# Valve Open Time-Out

### Problem/Condition

The throttle valve has failed to open during pump-down.

### Action

- Check throttle valve connection.
- Replace the digital I/O board.
- Replace the throttle valve.

# Valve Closed Time-Out

### Problem/Condition

The throttle valve has failed to close before injection.

### Action

- Check throttle valve connection.
- Replace the digital I/O board.
- Replace the throttle valve.

## Vaporizer out of range Call ASP Technical Service

### Problem/Condition

The current sensor has not detected activation of the vaporizer heater.

### Action

- Check vaporizer heater. Replace if necessary.
- Replace current sensor.

## VENT TIME OUT

### Problem/Condition

Atmospheric pressure was not detected by the end of the vent stage in vacuum, diffusion or at the end of the sterilization cycle.

### Action

- Check time and settings on Whitman Vacuum Switch and reset if necessary.
- Check LCD during vacuum switch test. Verify that setting is O. If not, reset for 2 seconds.
- Make sure vacuum switch retaining collar is tight.
- Make sure vacuum switch is operational.
- Check DC voltages
- Replace the vacuum switch
- Replace the pneumatic board.

## VENT TIME-OUT CALL TECHNICAL SERVICE

**Vent time-out. Call ASP Technical Service.**

### Problem/Condition

Atmospheric pressure was not detected by the end of the vent stage in vacuum, diffusion or at the end of the sterilization cycle.

### Action

- Check time on Whitman Vacuum Switch and reset if necessary.
- Check LCD during vacuum switch test Verify that setting is O. If not, reset for 2 seconds.
- Make sure vacuum switch retaining collar is tight.
- Make sure vacuum switch is operational.
- Check DC voltages
- Replace vacuum switch
- Replace pneumatic board

## VERIFYING CASSETTE PLEASE WAIT...

There is no printed message for this condition.

### Problem/Condition

The system is trying to read the bar code.

### Action

- Insert a new cassette.
- If the message persists, test the cassette optics.

## WARMING UP

**Problem/Condition**

Chamber is not a operating temperature.

**Action**

Allow chamber to warm up before attempting to run a cycle.

## WARMING UP CYCLE WILL START

**Problem/Condition**

Chamber is not at operating temperature.

**Action**

- Cycle starts automatically.
- Press **CANCEL** to remove load before start.

## WARMING UP PLEASE CLOSE DOOR

**Problem/Condition**

Chamber is not at operating temperature.

**Action**

Close the door and allow chamber to warm up before attempting to run a cycle.

## Suspected Leak

**Problem/Condition**

The leak back test results are greater than 25 mTorr; or there is evidence of a large leak in that the system cannot pump down below 700 mTorr.

**Action**

- Identify source of leak.
- Replace the failed unit.

Injector valve

Quartz window

Bellows and Vacuum O-ring clamps

Door seal O-ring

Vent valve

Throttle valve

RF feedthrough

# Continuous Positive BIs

## Problem/Condition

The biological Indicator test is repeatedly positive. The sterilizer is running normally in all other respects and the operator is performing the tests correctly.

## Action

- ✦ Ensure that vaporizer cap is free from damage and does not show signs of abnormal wear. Clean and or replace as necessary.
- ✦ Check injector valve height.
- ✦ Check cassette associated with the suspect process cycle. Open cassette and inspect for damage, residual H2O2, or physical abnormality.
- ✦ Review process parameter printer tape for suspect process cycle. Verify recorded injection pressure is correct.
- ✦ Review cycle history for previous 30 days. Report any process parameter printouts and records for any previous positive or suspect positive cycles.
- ✦ Make sure electrode screw is tight.
- ✦ Make sure all RF system connectors and screws are tight.
- ✦ Replace the electrode.

# Unit Does Not Print Black Characters During Black Character AutoTest

## Problem/Condition

During the AutoTest procedure the LCD indicates that the black character test is running correctly, however no black characters are printing.

## Action

- Check the printer ribbon.
- Check the positioning of the AutoTest connector. If it is off by one row of pins, the printer test malfunctions.
- Check the microprocessor board cables.
- Check the printer DIP switches for correct settings.
- Replace the printer.

# RF Amplifier Problems

## Problem/Condition

The RF amplifier appears to have failed. This is indicated by any one of the following:

- The front panel indicates that the reflected power is extremely high and the delivered power is low; the Bird Watt meter reads 400W
- Reflected power fails to stabilize within 20 minutes and/or drops below 100 mV (20 W).
- Delivered power fails to stabilize

## Action

- Check all connectors and screws on the RF match, the RF cable and the generator.
- Manually inject peroxide, then perform RF test with Bird Watt meter removed.
- If removing the Watt meter has little or no effect on the reflected power reading, clean the RF match connector and the RF connector with alcohol. Then CAREFULLY scuff the connector with needle nose pliers to make a better contact.
- Replace the RF cable.

- Replace the RF match.
- Replace the RF enclosure.
- Check the microprocessor board and replace if necessary.

***Note:*** *The RF match and enclosure may need to be replaced at the same time.*

# Leak Identification Tips

Do any one of the following to identify the source of the leak.

1. Take the sight glass apart (not present on Block 2) and inspect it for damage.
2. Check the KF-40, KF-16 and KF-25 O-rings and clamps on the vacuum subsystem and chamber. If they are cracked or loose, replace them.
3. Check the bellows for cracks, replace if damaged.
4. Check the door seal O-ring and replace if necessary.
5. Check the vent valve by isolating it with the plastic cap that comes with the throttle valve.
6. Check the vacuum switch and the O-ring that seals it. It may be too tight or too loose.
7. Isolate the throttle valve by stretching a bellows and installing it between the intake filter and the chamber connector. Replace the throttle valve if necessary.
8. Check the RF feedthrough and replace if necessary.
9. Isolate the vacuum pump by manually closing the throttle valve during pump down. Electrically disconnect the throttle valve. If the pressure does not rise when the throttle valve is closed, the leak is below the throttle valve—either in the pump intake filter or the pump itself. If the leak, continues the vent valve may be the problem..

# Minor Door Problems

*Note: The first procedure is not applicable to Block 2 systems.*

## *Noisy Door*

1. While closing the door, adjust the stops so that there is about a 3 mm gap between the stop and the door top.

## Door Does Not Travel Smoothly

1. If you notice the door touching the left rail as it ravels to the top, loosen both lower door cables.
2. Tighten the left cable first and then tighten the right one.

# Chapter 4

# *Vacuum Subsystem*

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# Introduction

This section details the vacuum subsystem. Included in this chapter are the theory of operation as it relates to the vacuum subsystem, the tools needed for vacuum subsystem maintenance, calibration of the vacuum subsystem, and removal and replacement of the vacuum subsystem and its various components.

# Different Subsystem Configurations

The STERRAD® 100 Sterilization System is currently in the **Block 2.0** and STERRAD **100 S** phases. These versions of the STERRAD 100 Sterilizer are very different, with regard to the vacuum subsystem, from previous versions of the STERRAD 100 System. There are Block 1.8 systems with Leybold D16A vacuum pumps and D16B vacuum pumps. The D16A pumps have exceeded their life expectancy and should continue to be used until they fail. At that time, the D16B pump can be installed in the Block 1.8 system as a replacement. Conversion information is contained in the removal procedures in this guide. More detailed conversion information is available from the ASP Services Help Desk.

If a Block 1.8 system with a D16A pump is going to be used with STERRAD 100 S Software, the pump musts be upgraded with a D16B oil return system as well as other upgrades so that it works correctly with the software.

Block 2 systems have D16B vacuum pumps. However, these pumps are a different part number even though they are configured and installed in the same manner. Differences in configurations are noted in the text. Systems equipped with the STERRAD **100 S** Software must have the D16B pump installed. STERRAD **100 S** Systems have an oil return system that is similar to **Block 2**. Removal, replacement and calibration procedures are the same for STERRAD **100 S** System as for the other systems unless otherwise notated in the text.

Differences in configurations are noted in the text. When you see the STERRAD icon next to the text, as with the above paragraph, that is the symbol for a configuration other than Block 1.8.

# Theory of Operation

The vacuum subsystem is controlled by the pressure transducer on the process chamber and by signals from the control subsystem. This subsystem evacuates the process chamber during the vacuum stage of the cycle and at the end of the diffusion stage; controls the vacuum in the chamber during the plasma stage, and admits filtered air to the chamber during the vent stage.

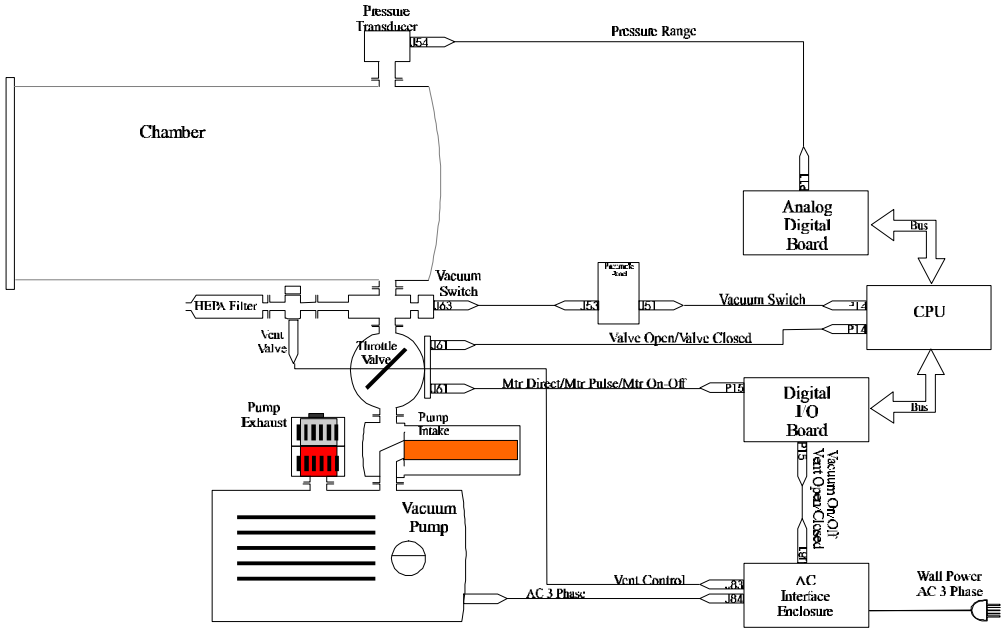


***Figure 4-1. Vacuum Subsystem***

## Vacuum Pump

The vacuum pump evacuates the process chamber during the vacuum stage of the sterilization cycle, and, under direction of the control subsystem, maintains the required vacuum during the sterilization cycle.

The vacuum pump is a two stage, rotary vane, with at least a 5.5 liters per 1 liter/sec (60 Hz) 4.6 liters a 1 liter/sec (50 Hz) pumping speed which includes an automatic anti-backflow valve so that less than 10-6 mbar times 1 liter/sec of helium leaks into the chamber with the pump turned off.

✔ *Note: The vacuum system has the capability of evacuating the empty, dry, STERRAD® sterilizer chamber to a pressure of 300 mTorr within 5 minutes.*

## Exhaust Filter

The exhaust filter is attached to the vacuum pump exhaust port. The air evacuated from the process chamber during the sterilization cycle passes through this filter before discharge into the atmosphere. The exhaust filter contains two elements, an oil mist filter and carbon filter. They must be replaced periodically.

## Oil Return Valve

This part is on **Block 2** and STERRAD **100 S** Devices. The oil return valve, a normally closed solenoid valve, is opened at the beginning of the vacuum stage for 5 seconds or 10 seconds (STERRAD **100 S** Systems) to allow oil to return into the vacuum pump from the exhaust filter.

## Throttle Valve

The throttle valve is operated by a digitally controlled stepper motor driven butterfly valve with an O-ring seal. The seal has a leak through rate of less than $2x10^{-6}$ mbar times 1 liter/sec of helium when closed, and a leak rate to the outside of less than $2x10^{-6}$ mbar times 1 liter/sec of helium. The valve is open during the vacuum stage, diffusion pump down phase, and vent stage, and closed during the injection/diffusion stage. The valve is precisely modulated to maintain the required vacuum in the process chamber during the plasma stage.

## Pump Intake Filter

The pump intake filter removes any residual hydrogen peroxide withdrawn from the process chamber before it reaches the vacuum pump, or is expelled into the room. This filter must be replaced periodically.

## HEPA Filter

Air admitted to the process chamber during the vent stage of the sterilization cycle is filtered by a High Efficiency Particulate Air (HEPA) filter. The HEPA filter removes dust and airborne organisms. The HEPA filter must be replaced periodically.

## Vent Valve

The vent valve, a normally closed solenoid valve, is opened to admit vent air into the process chamber during the vent stage of the cycle and to end an aborted cycle. The valve is sized to vent the chamber from 300 mTorr to Atmospheric pressure in less than 3 minutes. When closed, the valve does not leak through at greater than 10-6 mbar times 1 liter/sec of helium.

## Pressure Switch

The pressure switch monitors the chamber pressure sending a software signal when the chamber pressure is over 690 Torr. There are two types, the Whitman switch and the SMC switch (Block 2 only).

## Capacitance Manometer

Located external to, and on the upper left side of the process chamber, is a capacitance manometer with 12 VDC supply and 0-4 VDC output corresponding linearly to 0-10 Torr. The manometer is accurate to 0.25% of full scale, thermally stable to 3 mTorr per °C and exhibits less than 25 mTorr of zero drift long term. The linear output of the sensor also covers the range of 10-15 Torr with a linear output signal of 4-6 VDC and an accuracy of 2.0% of the reading. The output of this transducer goes to the control subsystem to control events during the sterilization cycle.

# Vacuum Subsystem Calibration

**IMPORTANT!:** Your first step when troubleshooting a system is to verify that the system is properly connected to the power source, and to make sure all the subsystems are properly connected to the AC system and all circuit breakers are on and functioning normally. Once you have verified these things, proceed with your troubleshooting steps.

### *Calibration Topics:*

Adjusting The Vacuum Switch

Vacuum Pump Ballast Valve Adjustments

Vacuum Subsystem Tests (AutoTest)

# Adjusting The Vacuum Switch

1. Insert the AutoTest board. Start the leak test menu. The display should read as follows:

   **LEAK TEST W/START**
   **NEXT W/ LONG CANCEL**

2. Plug the probes of a DVM into J63 connector (vacuum switch) with the chamber at atmospheric pressure. The voltage should be low (1 VDC).

3. With the chamber door closed, press START (this starts the pump) and time the signal change with a stop watch or similar timer.

4. Observe the DVM and when the signal goes high, stop the timer. The time for the voltage to go high (5.0V DC) should be between 10 and 28 seconds.

5. If the time is not between 10 and 28 seconds (preferably 20 seconds), loosen the locking collar on the body of the vacuum switch.

6. Rotate the switch (slowly) clockwise to increase the time, rotate the switch counterclockwise to decrease the time. DO NOT rotate the switch insert body.

7. Perform steps 3-6 after each rotation until the time interval is correct. Perform the final measurement with the locking collar tight.

8. For Block 2 systems, continue on to the Vacuum Switch test procedures below and in the AutoTest Appendix.

   ✔ ***Note:*** *Ensure the sterilizer is in the idle state. There should be no vacuum in the chamber.*

# Vacuum Switch Test- Block 2

1. On the vacuum switch use a fine pointed object to press the SET button. The LCD displays P1=xx, where xx is the value of P1. Use the up and down keys to set P1=0. Press the SET button again and the LCD displays the value of P2. Repeat the above procedure to set P2 through P4 to 0.

2. When P1 through P4 are all set to 0, the vacuum switch should be detecting atmosphere, and it beeps to indicate this. 0 is displayed and the red/green LEDs turn OFF.

# Adjustments and Settings

1. Again press the SET button. The LCD displays P1=xx, where xx is the value of P1. Use the up and down keys to set P1=70.

2. Press the SET button again and the LCD displays the value of P2. Use the up and down keys to set P2=15.

3. Press the SET button again and the LCD displays the value of P3. Use the up and down keys to set P3=70.

4. Press the SET button again and the LCD displays the value of P4. Use the up and down keys to set P4=15.

5. Press the SET button again and the switch returns to operation.

# Vacuum Pump Ballast Valve Adjustments

1. The ballast valve is located on the left side of the front face of the D16B pump. The lever should be turned in a counter-clockwise direction to the 1 or open position. Verify by checking that there is suction on the side of the pump.

2. The ballast valve lever is located on the top center area of the D16A pump and is covered by a black, rubber-like (BUNA-N) cap.

3. Start an empty chamber cycle, and allow the pump to run for about 2 minutes. This sets or checks the correct setting.

4. On the D16A pump align one of the cap holes with the hole in the valve so that it is fully exposed. Cover it with your finger to verify suction.

   ✔ ***Note***: *Visually aligning the holes may require the use of an inspection mirror.*

# Removal/Replacement Procedures

The procedure below details replacing the entire vacuum pump and its subassemblies. Each subsection can be used alone if only a single component is being replaced. The numbers in the diagram below match the steps of the removal procedures.

## Pre-Removal Procedures

Perform the following steps prior to removing any part of the vacuum subsystem.

1. Remove any vacuum from the chamber.
2. Turn off the power to the system.
3. Drain the oil from the pump using the oil draining procedures in the Planned Maintenance section. Do not replace the oil at this time.

## Remove the Bellows

1. Remove the KF clamps at the top and bottom of the bellows.
2. Squeeze the bellows together (use your hands) and remove them.
3. Remove the centering rings. Remove the elbow if applicable.

## Remove the Throttle Valve

The throttle valve assembly contains the vent valve assembly, the HEPA filter, and the vacuum switch assembly. Each of these is a field replaceable unit. Click on the one you want to remove.

To remove the throttle valve itself, unfasten the KF clamp between the throttle valve and the intake filter assembly taking care not to damage or lose the centering O-ring.

## Remove the Vacuum Switch

4. Disconnect the throttle valve wiring harness. Using two wrenches, unfasten the VCO connector holding the vacuum switch assembly to the throttle valve assembly. Remove by hand taking care not to lose or damage the O-ring inside the vacuum switch.

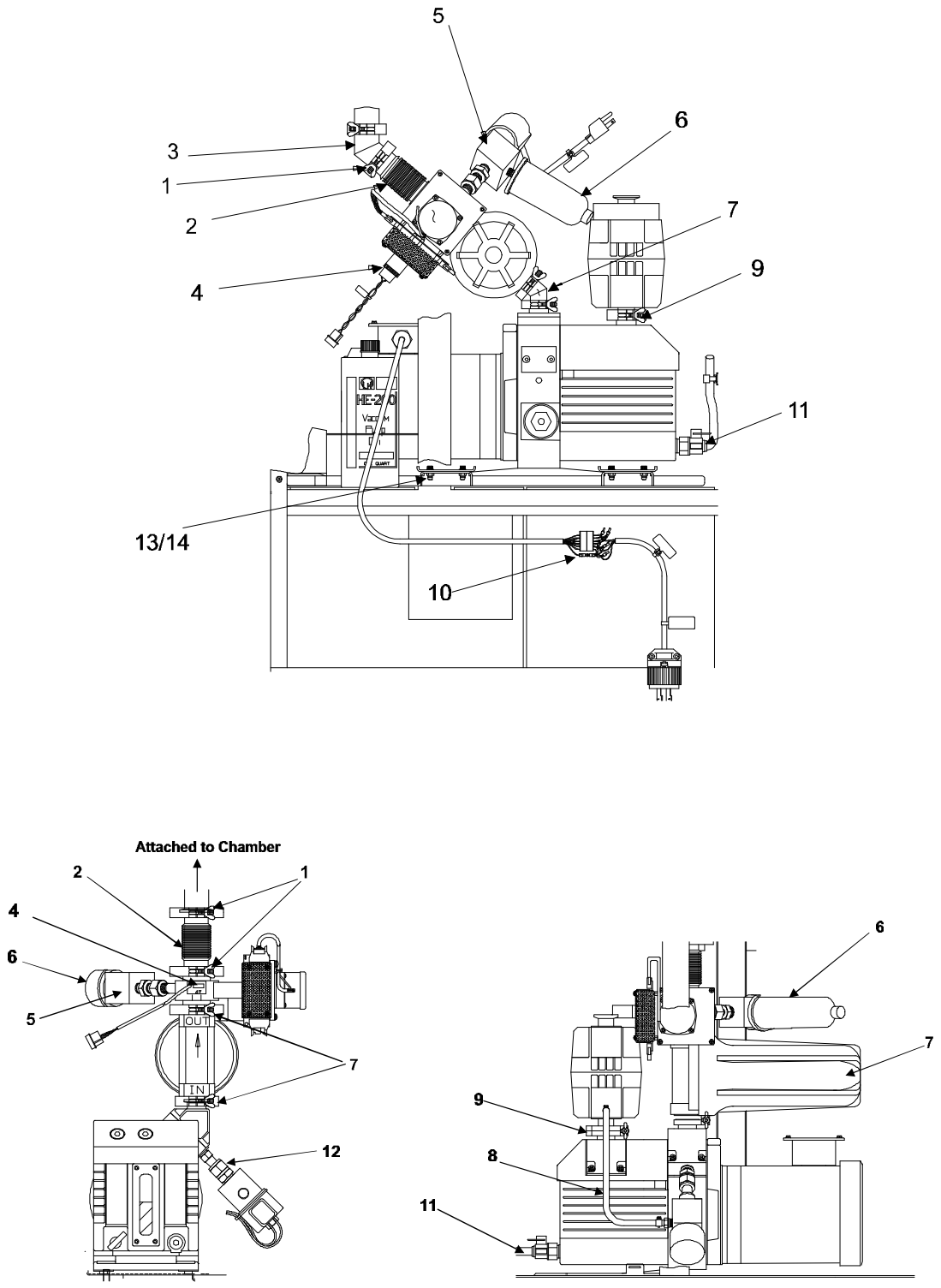


***Figure 4-2. Vacuum System Remove Steps***

## Remove the Vent Valve

5. Using two wrenches, unfasten the VCO connector securing the vent valve assembly. Remove by hand taking care not to lose or damage the O-ring inside the vacuum switch.

## Remove the HEPA Filter

6. Unscrew the HEPA filter element from the nipple attached to the vent valve. Re-tape the nipple with Teflon tape prior to replacement.

## Remove the Intake Filter

7. Remove the throttle valve first. Unfasten the KF clamps securing the intake filter assembly to the throttle valve and the pump. Remove the centering ring and lower elbow if applicable.

## Remove the Exhaust Filter

8. Disconnect the oil return hose (Block 2).

9. Unfasten the KF-25 clamp securing the exhaust filter to the pump.

## Remove the AC Connection

10. Unfasten the ground from the cabinet (Block 2) or the ground connection on the AC harness adapter. Unplug the pump from the AC enclosure (Block 2.0) or from the AC harness adapter. Cut the cable ties and free the cable.

## Remove the Drain Valve

11. Unscrew the drain valve as an entire unit.

✔ ***Note:*** *Drain valve replacement requires the use of the drain valve kit.*

# Remove the Oil Return Valve

12. Unfasten the VCO connector securing the oil return valve to the pump. (Block 2 and STERRAD 100 S Systems).

# Remove the Pump

13. Remove the 8 bolts and washers securing the pump to the sump plate. (For D16A pumps there are 4 bolts fastening the pump feet to the frame.)

Block 2. Remove the 17 mm bolts fastening the front of the pump to the unit. Loosen the 2 rear 17 mm bolts. Slid the pump to the rear using the built-in handle. You may also cut the banding straps retaining the pump to the tray and then remove the pump without unbolting it.

14. Make sure the pump is no longer attached to the frame either with bolts or cabling. Slide the pump toward the rear of the unit and remove.

**WARNING! The pump is very heavy, if possible have someone help you or slide the pump onto your closed tool box to move it out of the way.**

# Replacement Set-Up

Check that all vacuum fittings to be installed are clean and free of foreign material

Lightly coat all O-rings and seals with a thin film of high vacuum grease before assembly

Note the orientation of the pump in the illustrations. The drain valve is oriented toward the front of the sterilizer on the Block 1.8 units. It is oriented toward the rear of the sterilizer on Block 2.0 units. The bellows assembly requires two elbow connections on Block 1.8. The bellows is attached straight up on Block 2.0 units.

Be sure the vacuum pump sump plate or the pump tray, is attached to the pump platform in the proper orientation. The pump motor is at the sloped end of the plate.

If you are converting a D16A pump to a D16B, be sure you have the conversion kit and conversion documentation from the ASPS Help Desk.

The numbers in the diagram below match the steps in the replacement procedures. The top illustration is a Block 1 unit. The bottom is a Block 2 unit.

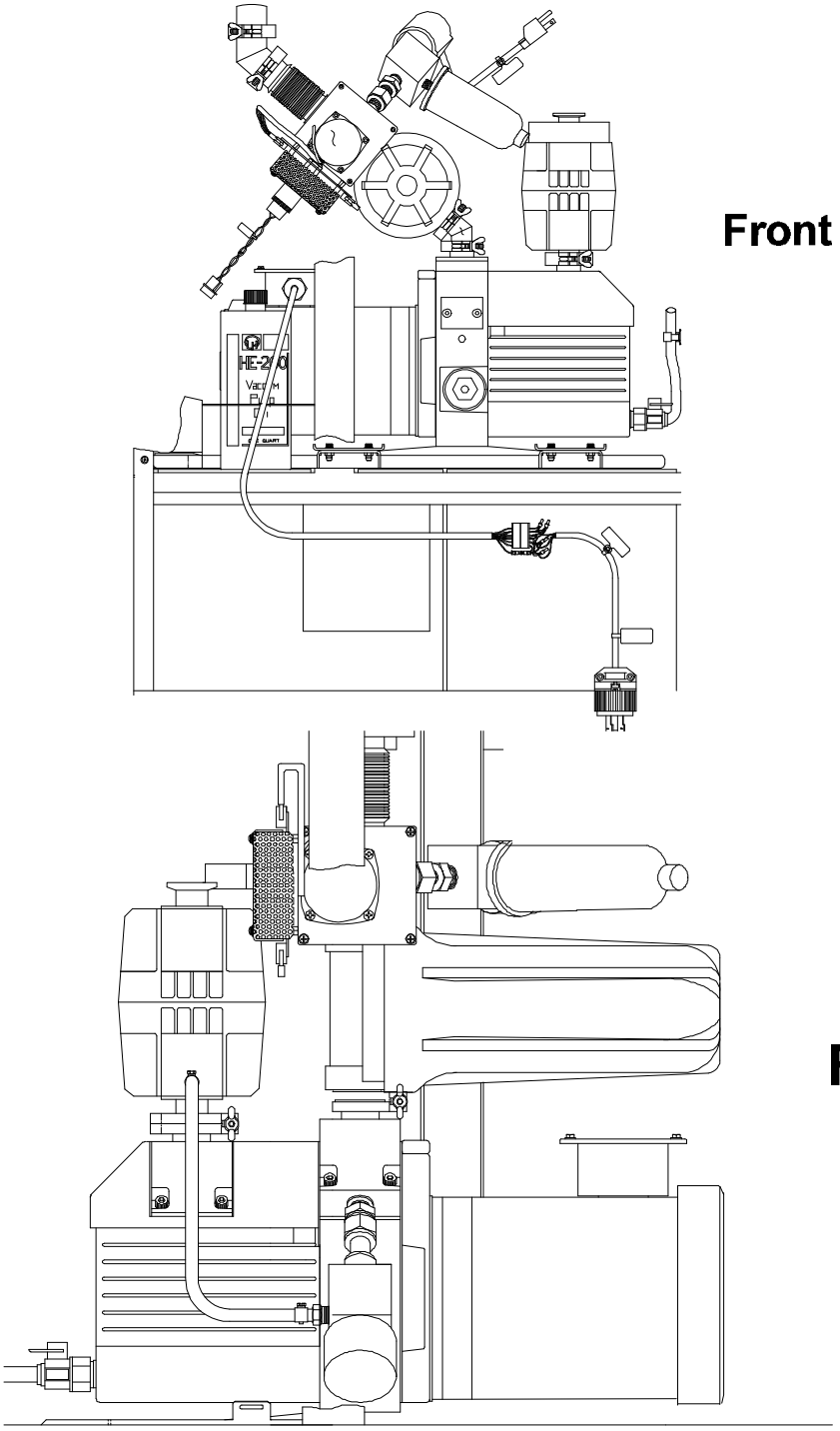


***Figure 4-3. Vacuum Subsystem Replacement Procedures***

# Attaching the Pump

If you are performing a conversion of a D16A pump to a D16B, you must obtain more detailed conversion instructions from the ASPS Help Desk.

1. Block 2: If you have removed the pump tray, reattach it with the 17 mm bolts. Attach the vacuum pump to the sump plate (Block 2 or place it on the tray). Lightly secure the nut plate straps.

2. If it has been removed, attach the drain valve to the pump. (New pumps are usually shipped with the drain valve assembly already installed.)

3. Open the gas ballast valve. Attach the oil drain tube to the vacuum pump oil drain ball valve. Fasten the tube with a hose clamp. Attach the tubing to the frame.

# Replace the HEPA filter

4. Attach the HEPA filter.

# Replace the Intake Filter

5. Install the filter outlet flag on the side of the pump marked IN. (If you are performing an A to B conversion, the removed flange is a KF-40 and the installed flange is a KF-25.) Tighten the flange using a KF-25 clamp.

6. Attach the pump intake filter assembly to the elbow with the housing on the right side of the machine (viewed from the rear) and secure with the centering ring and clamp. Verify that the flow arrow on the filter body points away from the pump and the IN port connects to the elbow.

# Replace the Throttle Valve

7. Attach the throttle valve assembly to the OUT side of the intake filter assembly.

8. Verify that the valve actuator is vertical and the intake filter side is on the HI VAC side of the pump.

9. Attach the elbow to the chamber port. Align the elbow to the throttle valve.

10 Attach the bellows between the throttle valve and the elbow. Adjust the pump, or elbow, for optimum alignment. There should be minimal flexing of the bellows. Us the centering rings and clamps to secure.

## Replace the Bellows

10. Attach the bellows between the throttle valve and the elbow. Adjust the pump, or elbow for optimum alignment. There should be minimal flexing for the bellows. Use the centering rings and clamps to secure.

## Replace the Vacuum Switch

11. Attach the vacuum switch using the VCO connector.

## Replace the Vent Valve

11. Attach the vent valve assembly.

12. Orient the assembly with the solenoid opposite the HI VAC side of the throttle valve and parallel to the bellows. Secure the VCO fitting.

## Replace the Exhaust Filter

13. Attach the vacuum pump exhaust filter to the pump exhaust. The drain plug should be on the side clear of the pump and the flow arrow should point up.

## Replace the Oil Return Valve

14. Attach the oil return valve to the pump using the VCO connector.

## Attaching the Power Cables

15. Secure the nut plate straps.

16. Attach the harness adapter to the plug end of the vacuum pump cable. Plug the connectors together and join the ground lugs with the external tooth lockwasher trapped between them. Secure with the flat washer and lock nut. The proper connectors are included in the conversion kit.

17. Route the harness beneath the pump platform. Connect the pump to the AC enclosure.

# Chapter 5

# Injection Subsystem

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# Introduction

This chapter details the injection subsystem. Included in this chapter are the theory of operation as it relates to the injection subsystem, the tools needed for injection subsystem maintenance, calibration of the injector pump, and removal and replacement of the injector pump and vaporizer valve.

# Different Injection Subsystem Configurations

The STERRAD® 100 system is currently in the **Block 2** and STERRAD **100 S** System phases. The **Block 2** version of the STERRAD 100 Sterilizer is different, with regard to the injection subsystem, from previous versions of the STERRAD 100 system. The injector pump has the same appearance from Block 1.8 to **Block 2**. However, it has a different part number. The pump is backwards compatible provided that the front bracket (**Block 2**) is used on the Block 1.8 systems.

The STERRAD **100 S** Software enables the system to perform two injections per cycle and for sterilization times to be shorter. The only effect on the calibration or removal/replacement of the injection subsystem is in the cassette used. Be sure to use the appropriate cassette when testing the system.

Differences in configurations are noted in the text. When you see the STERRAD icon next to the text, as with this paragraph, that is the symbol for a configuration other than Block 1.8.

# Theory of Operation-Injection Subsystem

The injector subsystem is a mechanism secured to the top of the process chamber and connected to the chamber interior through a normally sealed injection port.

The injector pump senses and accepts a disposable cassette inserted through the cassette door by the operator, and reads the bar-coded cassette type and expiration date information on the cassette. The STERRAD **100 S** equipped systems use the same type of cassette as STERRAD 100 Systems, however the bar-code is very different in that it allows the cassette to be used for two injections per cycle.

If the cassette is out of date, it is rejected and the control subsystem presents an appropriate message on the front panel LCD. If the cassette is accepted, it is advanced into the unit to position the next available cell at the injection aperture. A signal is transmitted to inform the control subsystem that a good cell is available for the next cycle.

A pneumatically driven clamping mechanism presses the cassette down onto a needle which punctures the hydrogen peroxide cell. Air pressure applied through the clamp collapses the cell and forces the hydrogen peroxide into the injector valve.

The injector valve pierces and connects the cell to the chamber through a pressure relief valve that provides the vacuum seal. The valve incorporates a chamber and heater to vaporize the $H_2O_2$ and deliver the vapor to the chamber.

A few seconds into the diffusion cycle, the cassette is indexed to the next usable cell. If that cell is found to be the last on the cassette, the control system displays a related message on the front panel LCD at the end of the cycle. If the last cell has been used, the cassette is ejected towards the rear of the injector pump subsystem and, as the next cassette is inserted, the used cassette falls into the cassette collector box.

The cassette collector box holds 30 used cassettes. When the box is full, the front panel displays a message informing the operator that the cassette collector box must be replaced before another sterilization cycle can begin.

# Cassettes

The hydrogen peroxide is contained in a disposable cassette. Each cassette has ten cells containing premeasured, concentrated hydrogen peroxide.

**WARNING! Disposable cassettes contain concentrated (58%) hydrogen peroxide which is a powerful oxidizer and irritant. Do not remove the plastic wrap from the cassette if the chemical indicator on the cassette box has turned red. IF THE INDICATOR IS RED, THE CASSETTE HAS BEEN DAMAGED. Return all damaged cassettes, unopened, to ASP Customer Support.**

An inserted cassette is pressed under a roller and sensed by the cassette sensor (a reflective optical device) and advanced to read the bar-code. If the bar-code, as read by the cassette sensor, indicates a valid cassette, the cassette is advanced, and the first of the ten positioning marks on the side of the cassette is moved past the sensor.

Each cassette carries coded information printed on the right side of the cassette shell. On the lower half of the shell is bar-coded date of manufacture (month, year) and cassette application information with a parity bit. On the upper half is printed the lot code and date of expiration in Arabic numerals. Decoded bar-code information is not needed in the field.

## Error Handling

If the cassette is inserted incorrectly, or if the cassette sensor finds no bar code within the time allotted, the cassette is ejected to the operator with the appropriate message displayed on the LCD. If the bar-code is located, but indicates a cassette out of date or incorrect cassette type, the bar-code is read a second time to verify the data.

If the bar-code is read twice as an incorrect type, the cassette is ejected to the operator. If the bar-code is read twice as cassette out of date, the cassette is passed to the cassette collector box.

## Power Failure

If the power fails during injection, or the first 4 minutes of diffusion, the cassette is positioned at the next available cell when the power is restored. If the cassette is at a mark, it does not advance until after the next attempted injection.

If power fails when the system is idle, the cassette is advanced to the next position when power is restored.

# Injection Subsystem Calibration

**IMPORTANT!:** Your first step when troubleshooting a system is to verify that the system is **properly connected to the power source**, and to make sure all the **subsystems are properly connected to the AC** system and all circuit breakers are on and functioning normally. Once you have verified these things, proceed with your troubleshooting steps.

The injection subsystem, consisting of (for the purposes of this guide) the injector pump, chute and cassette collection box should be calibrated when the unit is replaced, when there is a malfunction as detailed in the removal procedures, when product certification shows faults in the system.

**WARNING! $H_2O_2$ EXPOSURE! Before touching the injector valve, be sure there is no sign of $H_2O_2$ residue. If there is, be sure to wear gloves to prevent $H_2O_2$ exposure.**

## Injector Valve Height

1. Manually extend the injector cam and insert the cassette gap tool (injector valve gage) from the back of the platen. Position it on the injector valve seal retainer plate over the injector valve needle seals.

✔ ***Note:*** *Lower the injector valve to obtain required clearance to insert tool over injector valve.*

2. Raise the injector valve by turning the injector valve adjustment screws clockwise until no gap exists between the clamp seal block and the cassette gap tool (the O-ring should fit into the cutaway of the tool). Adjust the valve height to a point where the cassette gap tool is difficult to remove.

3. Remove the cassette gap tool.

# Injector Valve Height-Block 2

1. Fully extend the injector pump cam and leave it extended. From the back of the platen, insert the cassette gap tool (injector valve gage).

✔ ***Note:*** *Using an Allen wrench, raise the injector pump clamp seal block by rotating the Allen screw on the knob at the bottom of the seal base. This creates the required clearance needed to insert the tool over injector valve.*

2. Loosen the set screw on the injector seal block adjustment knob.

3. Push platen down to allow the tool to advance on top of the injector valve.

4. Verify that the seal block O-ring and needle seals clear the opening in the cassette gap tool.

5. Lower the seal until no gap exists between the seal block and the tool or between the needle seal retainer plate and the tool. Lock the seal with the set screw.

6. Remove the cassette gap tool.

# Injector Pump Valve Adjustment

This calibration/adjustment is only applicable to **Block 2** devices.

1. Loosen *but do not remove* the two rear screws mounting the injector pump to the injector boss.

2. Adjust the locknuts and mounting hardware at the front of the injector pump so that an inserted or ejected cassette passes evenly centered through the front panel cassette door without sticking or binding on any surface. Secure the locknuts and mounting screws.

3. Using the cassette gap tool, re-check the injector valve setting from injector pump clamp. Perform the check with the cam fully extended and adjust if necessary so that tool is fully contacting seal clamp plate of injector valve and clamp base (not the O-ring) of the injector pump clamp.

✔ ***Note:*** *Be sure to use the appropriate cassette for STERRAD 100 Systems or for STERRAD* **100 S** *Systems. They are different.*

4. Place a piece of tape (Scotch Brand type) on the bottom of a **used, empty** cassette. (Do not use a cassette containing any $H_2O_2$.) Insert a cassette into the injector pump and operate the solenoid (without speed controls) so that a manual injection is performed.

5. Remove the cassette and inspect where the needles pierced the tape and the cells. It should be as close as possible to the center of the openings in the cassette. Make any adjustments in the location of the injector pump/valve needed to achieve this.

6. After this adjustment is completed, it may be necessary to re-adjust the front panel so that the cassette does not catch on the opening.

✔ ***Note:*** *The location of the injector pump relative to the injector valve is a priority over the appearance of the cassette in the opening, as long as no interference exists. Any further adjustments to the position of the injector pump requires that the minW be reset.*

# Cassette Optics

Calibrating the cassette optics requires two sets of steps. First is the adjustment set-up that starts the diagnostic software, then there is the cassette optics test itself that allows you to make adjustment to ensure the correct tracking of the cassette through the injector pump.

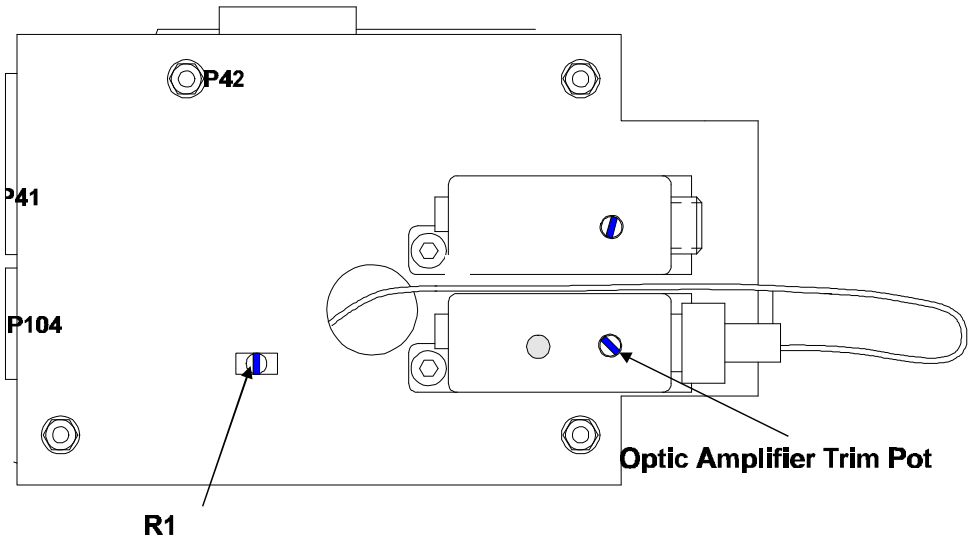


***Figure 5-1. Cassette Optics***

### *Cassette Optics Adjustment Set-Up*

1. Open the control enclosure and interrupt power to the enclosure by using the safety interlock.
2. Remove the microprocessor board, and install the AutoTest board.
3. Apply power to the enclosure using the safety interlock.
4. Perform the AutoTest procedures.
5. Continue on to the cassette optics procedure to correct speeds and for minimum (minW) adjustment.

### *Cassette Optics Adjustment*

1. Start the test as shown previously in the cassette optics adjustment set-up.
2. Perform the cassette sensor tests using the AutoTest board.

## Injector Pump Floating Guide Adjustment

The purpose of this adjustment is to ensure the cassette tracks freely through the pump, is under control at all points and the cassette bars are a constant dimension from the sensor tip.

1. Start the cassette adjustment test and press **START** on the control panel.
2. Insert an appropriate cassette (STERRAD 100 Cassette or STERRAD 100 S Cassette) so that the leading edge is approximately 20 mm past the drive roller. Watch the cassette as it travels on to the rear portion of the injector pump. Observe the gap between the floating guide and the cassette. The gap should be less than 0.5 mm. Press **CLOSE DOOR** to stop the cassette from traveling.
3. Manually position a cassette between the points being adjusted (rear and middle or middle and front).
4. Loosen the screws fastening the guide to the platen. See the diagram.
5. Move the guide towards the cassette with a flat blade screwdriver. Apply pressure to the guide while tightening the floating guide mounting screws. Begin with the middle screw.
6. Do not over tighten the fasteners, as this can deform the plastic guides. Operate the platen several times to check that the cassette enters freely.

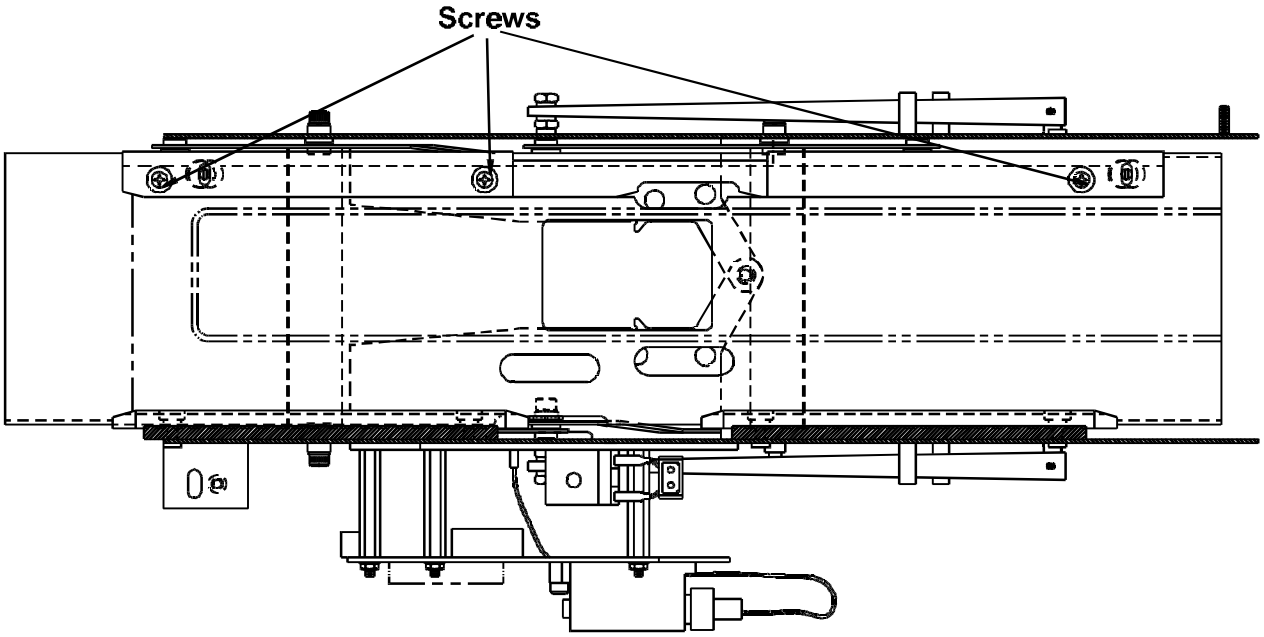


***Figure 5-2. Floating Guide Adjustment***

# Injector Pump Pneumatics

The injector pump pneumatics are factory set with the aid of optical and air flow sensors. Do not attempt to adjust the speed control valves in the field.

# Injection Subsystem Removal/Replacement

The injector pump is easy to misalign so careful testing following installation is important. Be sure to perform all of the calibration and certification steps to verify that the pump is installed and working correctly.

## Pre-Removal Procedures

1. Disconnect power to the system.

2. Use a step stool or ladder to reach the injector pump from the top of the system.

✔ ***Note***: *It is not necessary to completely remove the injector pump in order to remove the injector valve (not applicable to Block 2). Perform steps 1 and 3 below and leave the pneumatic and electrical connections in place.*

## Remove the Injector Pump

1. Remove the 3 mm Allen screws fastening the injector pump to the injector boss. Save the screws to use for reattachment.

2. Remove the pneumatic and cassette door connections leading to the injector pump.

3. Detach the injector pump from the cassette chute assembly. Push the injector pump gently towards the chute until it disengages.

## Replace the Injector Pump

✔ ***Note:*** *The installation of the injector pump can cause the sheet metal to bend. This directly affects required cassette clearances Be sure to follow the installation procedures exactly.*

When reattaching the injector pump, be sure that no metal stress occurs. The sheet metal can be pulled to the left or right at the rear of the pump or up and down at the front of the pump if the pump is not attached properly. Attachment procedures are shown below.

1. Place the injector pump on the chamber. Align the front and center mounting holes. (See the diagram.)

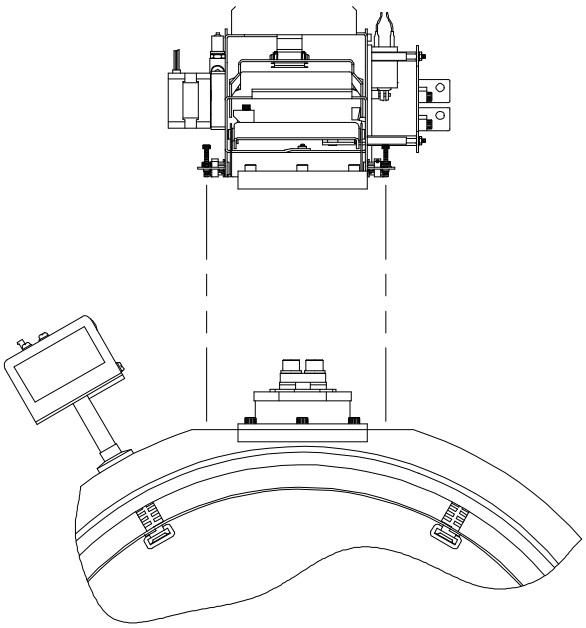

***Figure 5-3. Block 1 Injector Pump***

2. Using a 3 mm hex ball driver, loosely attach the center screws securing the pump to the chamber injector boss.

3. Attach the cassette chute assembly to the injector pump.

4. Attach the connections to the injector pump.

5. Insert an appropriate cassette (STERRAD 100 Cassette or STERRAD 100 S Cassette) into the pump through the cassette door prior to securing the pump. The cassette should be inserted to the point where it just passes the drive roller.

6. Align the front of the injector pump so the cassette is positioned 3 mm from the top and centered (from the side) in the cassette door opening. Secure the screws, using the jack screws to position the injector pump.

7. After fastening the front of the pump to the machine ensure that the rear injector pump/cassette chute mounting stud is in the chute slot.

8. Tighten the center screws securing the pump to the chamber injector boss.

9. Before placing nut on the rear mounting stud, check the clearance of the platen cutout from the injector valve. There must be a minimum of 1 mm of clearance between the platen cutout and the injector valve.

10. Place the chute fastening nut on the rear of the pump. Hand tighten only. Adjust the position of the chute, aligning it with the pump by loosening the mounting screws from the frame. Manually push down on the platen assembly several times.

11. Perform the injection system calibrations including a leak back test shown in the following section.

12. When the injector pump, optics etc., have been properly calibrated, start a cycle, then cancel it when it enters diffusion. Repeat twice to ensure proper operation of the injector subsystem.

### *Block 2 Injector Pump Removal*

1. Loosen but do not remove, the 4 hex screws (2 on each side of the pump in the front).
2. Unfasten the rear chute (some adjustment procedures only require that the chute be loosened.)
3. Loosen, but do not remove, the 2 Phillips screws attaching the pump to the injector valve.
4. Disconnect the wiring harnesses and pneumatic connections.
5. Move the pump to the rear and lift up to remove.

### *Block 2 Injector Pump Replacement*

1. Place the pump near the rear of the chamber and move it toward the front until it is located over the injector valve.
2. Reconnect the wiring harnesses and pneumatic connections.
3. Tighten the 2 Phillips screws attaching the pump to the injector valve.

   ✔ ***Note:*** *If you have replaced the injector valve, this is the point when you retighten the injector valve screws.*

4. Reattach the cassette chute.
5. Tighten the 4 hex screws (2 on each side of the pump in the front).

## Remove the Injector Valve

The injector pump must be removed, or loosened, prior to removing the injector valve.

1. Remove the hex screws fastening the injector valve to the chamber.
2. Disconnect the vaporizer heater cable.
3. Place your hand inside the chamber to catch the injector valve. Press down on the injector valve to drop the entire unit into the chamber.

# Block 2 Injector Valve/Vaporizer Removal

✔ ***Note:*** *The injector pump must be removed, or loosened, prior to removing the injector valve.*

1. Remove the 2 screws attaching the valve to the vaporizer. Lift the valve up.
2. Disconnect the vaporizer heater cable.
3. Insert the spanner wrench into the retaining ring holes, turn it counter-clockwise.
4. Place your hand inside the chamber to catch the vaporizer. Press down on the vaporizer to drop it into the chamber.

# Replace the Injector Valve

1. Make sure the injector boss is clean so as not to damage the new O-ring. Insert the injector valve through the opening from inside the chamber until the O-ring catches and holds the valve in place.
2. Reinsert the screws and tighten with the hex wrench. Than back-off 3 complete turns. Seat the valve by pushing down.

3. This step is for Block 2 systems: with the heater assembly in place insert the vaporizer through the top opening from inside the chamber.
4. Place the spacers in their proper grooves (one is large than the other). Insert the O-ring and hand tighten.
5. Once the vaporizer is hand tight, use the spanner wrench to tighten completely.
6. Reinstall the injector valve into the vaporizer and reinsert the screws; do not tighten at this point.

# Chapter 6

# *User Interface and Control Subsystems*

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# Introduction

This chapter details the user interface subsystem. Included in this chapter are the theory of operation as it relates to the user interface and the software, the tools needed for maintenance, replacement of the user interface.

# Different User Subsystem Configurations

The STERRAD® 100 system is currently in the **Block 2.0** and STERRAD **100 S** System phase. These versions of the STERRAD 100 Sterilizer are different, with regard to the user interface, from the Block 1.8 STERRAD system.

- The printer paper outlet is higher up on the panel.
- The software varies extensively between STERRAD 100 Systems and STERRAD **100 S** Systems.
- The **Block 2** membrane switch has many more language choices available than on the Block 1.8.
- When you see the STERRAD icon next to the text, as with this paragraph, that is the symbol for a configuration other than Block 1.8.

# Different Controller Configurations

The STERRAD® 100 system is currently in the **Block 2.0** and **STERRAD 100 S** phase (100 S denotes a short cycle system). The **Block 2** version of the STERRAD® 100 Sterilizer is slightly different, with regard to the control subsystem, from previous versions of the STERRAD® 100 System. These differences are mostly in appearance. Calibration and removal/replacement differences are noted in the text. The controller is backwards compatible.

# Theory of Operation

The STERRAD Sterilization Process occurs in the following manner:

- The items to be sterilized are placed in the sterilization chamber, the chamber is closed, and a vacuum is drawn.
- An aqueous solution of hydrogen peroxide is injected into the chamber where it vaporizes, surrounding the items to be sterilized.
- After a period of hydrogen peroxide diffusion, the pressure is reduced in the chamber. The formation of a low-temperature gas plasma is initiated by applying radio frequency (RF) energy to create an electric field.

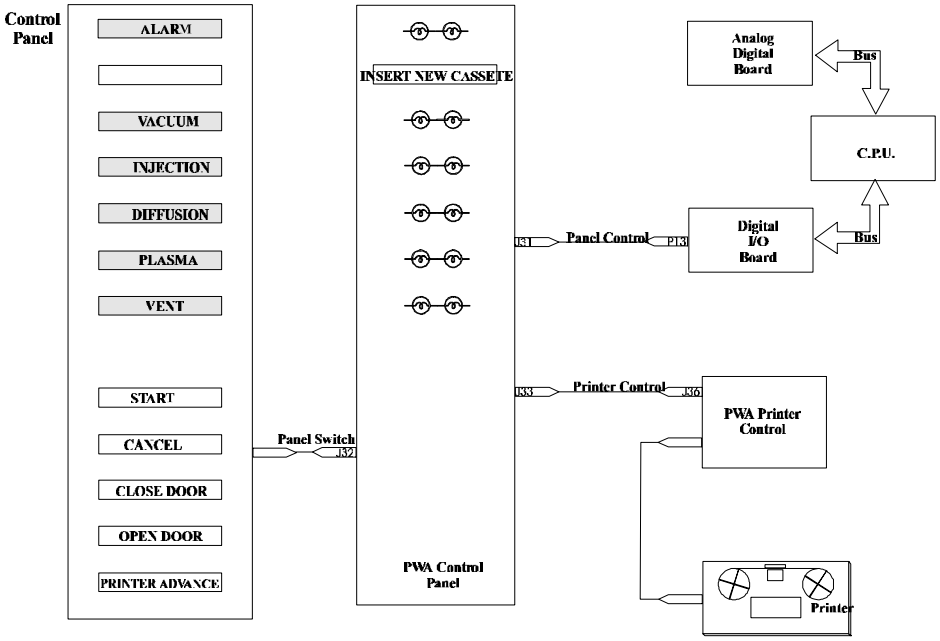


***Figure 6-1. User Interface Block Diagram***

- In the plasma state, the hydrogen peroxide vapor beaks apart into reactive species that include free radicals. The combination of hydrogen peroxide vapor and plasma, safely and rapidly sterilizes most medical instruments and materials without leaving toxic residues.
- Following the reaction, the activated components lose their high energy and recombine to form primarily oxygen, water and other non-toxic by-products.
- When the process is complete, the RF energy is turned off, the vacuum is released and the chamber is returned to atmospheric pressure by venting through a High Efficiency Particulate Air (HEPA) filter. The items within are sterilized and ready for use.

# User Interface Subsystem

The user interface subsystem consists of the interface panel containing touch sensitive push-button controls, event indicators, a two-line alphanumeric LCD display, and the printer with its attached printed-circuit board control interface.

The printer's paper roll and ink ribbon are easily replaced. The printer access drawer is located below the paper feed slot. Pull it forward to change the paper roll and printer ribbon. Below the printer drawer is another, larger vertical drawer for storage of cassettes, printer rolls, printer ribbons, and other system accessories.

The STERRAD **100 S** System uses the same membrane switch panel as **Block 2** systems. This panel has multiple language choices on the key pad.

Software controls the STERRAD 100 and **100 S** Sterilizers to ensure the most efficient sterilization process as well as ease of use and operator safety. The STERRAD 100 Software manages the sterilization process throughout the five stages: vacuum, injection, diffusion, plasma, and vent. The software also monitors pressure, temperature, and other factors to determine when to move from one stage to another, what to adjust in the various stages, and when to abort the process if there are problems. The software controls the machine in the monitor state including the processing of hydrogen peroxide cassettes. STERRAD 100 S Operation is shown later in this chapter.

## *Program Structure*

The software is divided into three program elements (main control, editor, and process).

The **Main** module accomplishes the following tasks:

- Digital I/O read and write
- Determine mode (edit or process)
- Cassette management
- LCD display
- Chamber door control
- Temperature control

The **Edit** module controls the update of the system date and time as well as the serial number, total machine cycles, and the preventative maintenance display. It uses parts of the main program (such as digital I/O) to perform some of its tasks.

The **Process** module monitors the sterilization process as it occurs and call each of the stages in turn:

- Vacuum
- Injection
- Diffusion
- Plasma
- Vent
- Abort cycle

All of these modules, including the abort cycle, use parts of the main program to perform their tasks.

Three types of input data are accepted by the software. Analog inputs (temperature, pressure, and RF power) are converted to digital readings and interpreted by the software. Operator inputs (inserting cassettes and pressing pressure switches) are read as digital inputs. All other sensors used as inputs to the system are digital.

Digital and analog inputs are used to monitor all phases of the process, just as digital outputs control the process.

## *Output Data*

Outputs to the operator include LCD messages, printed messages, control panel lights, audible beeps, and the opened or closed door.

Digital outputs to the machine's hardware components are used in every stage of the sterilization process to perform tasks such as opening and closing the throttle valve, controlling the RF power, and communicating with the printer.

The software runs a 100 millisecond interrupt as its highest priority interrupt. If the "heartbeat timer" interrupts any segment of the software, other than the monitor state, the software goes to cancel/abort processing and provides a controlled failure rather than system lockup.

In three cases 100 milliseconds is too long for the system to wait between cycles. For these three areas the software uses a 10 millisecond interrupt as an interrupt for faster processing:

- the throttle valve controller
- the bar code reading
- cassette positioning mark detector

## Software Safety Considerations

The software is designed to shut down certain functions for safety reasons. These functions are listed below.

- The output of the RF generator shuts down when faced with mismatches of greater than 1.5 VSWR to protect personnel from the RF shock.
- The door over center sensor is monitored to protect personnel from hazards.
- The active low digital output design forces a graceful shut down in the event of failure in any device or harness.
- The door remains closed if a power failure occurs during a running cycle.
- The door automatically reverses if there is an obstruction of 14 kg (30 lbs) or more.
- The RF power can not be activated if the chamber pressure is over 700 mTorr.
- If a failure occurs, a 10 minute CANCEL CYCLE runs to prevent exposure of the operator to $H_2O_2$ vapor.

| Process Parameter | Tolerance |
|---|---|
| Time | 1 sec |
| Pressure | 25 mTorr |
| Temperature | 2.5 C |

- The operator controls are located on the control panel at the front top right of the sterilizer and include the following push button controls:
- START -Initiate a cycle after automatically closing the door, if necessary. At the end of a successful cycle, the door remains closed.
- CANCEL - Stops the cycle and opens the door at the end of the CANCEL operation.
- OPEN DOOR - Opens the door when the machine is in idle mode.
- CLOSE DOOR - Closes the door.
- PAPER ADVANCE - Advances the printer paper while the switch is pressed.

## Edit Mode

The date, time, PM, clock mode, reset, serial number, and total machine cycles can be set using the Edit mode.

# Controller Operation

The machine functions are based on analog signals from transducers and digital signals from sensors and front panel controls. The control subsystem processes the input, controls the process through digital output, and sends messages to front panel, displays, indicators, and to the printer.

| Parameter | Description |
|---|---|
| Size | 305 mm W x 355 mm H x 215 mm D |
| EMI Shielding | Exceeds CISPR and VDE 871 Class A standards |
| Safety | Exceeds IEC 601-1 and UL standards |
| Cooling | 25 CFM whisper fan |

## *Microprocessor Board*

The microprocessor board (CPU) is based on Zilog's Z80A 8 bit microprocessor clocked at 4.0 MHz. There are a total of 64 Kbytes of memory organized as 56 Kbytes of EPROM and 6 Kbytes of lithium battery backed SRAM. The word sizes are 8 bits for the data bus and 16 bits for the address bus.

The control computer consists of discrete, purchased boards for the CPU/digital input, digital output, and analog input functions communicating via a STD Bus. The CPU board includes 16 TTL compatible digital input ports with integral pull up resistors, two RS-232 serial interfaces, and four counter timer clocks.

The CPU for Block 2 devices is a 64180 standard bus microprocessor with a full Z80 instruction set. It is clocked at 6.0 MHz and has off-board memory expansion capabilities and a watch-dog timer. There are a total of 512 Kbytes of memory organized as 128 Kbytes of EPROM and 128 Kbytes of lithium battery backed SRAM.

The board contains: a two channel DMA controller, a 2 channel async serial RS232 controller, a 16 bit programmable timer and a twelve source interrupt controller. The CPU also has two 8-bit parallel digital I/O with handshaking capabilities (8420 PIO) and a counter/timer controller with four additional 8 bit counter/timers (8430 CTC).

## Digital I/O Board

The digital I/O board from the VersaLogic Corporation is designed to interface directly with the system. It provides 48 I/O lines for control purposes and features 8 and 10 bit addressing. These lines are configured as two 24-channel groups connected through two 50 pin I/O connectors. The digital I/O occupies 8 consecutive I/O addresses and uses two latching 50 pin headers of the I/O connections.

Each input channel is individually filtered to minimize noise induced errors at the input buffer. Reading a channel that is currently programmed as an output, reads the current state of the output line (output readback). Each output line is latched, fully buffered and is automatically cleared during system reset.

## Analog-to-Digital Converter

The analog-to-digital converter performs 12-bit conversion of any one of 16 selectable analog input channels. Conversion is controlled by the host microprocessor system via the STD bus, providing channel selection and free run or convert on demand.

Completion of a conversion cycle signals the processor through use of interrupts or a status bit. Data consists of 12 data bits, a polarity bit, over-range bit and status bit organized as two bytes. The base address is chosen by placement of straps in the address decoding portion of the card.

The converter includes:

- 12-bit binary A/D converter
- 16 channel analog multiplexer·
- Straps for user-selectable address decoding
- Crystal controlled clock·
- 20 pin external header connection for the analog signal input.
- 14 pin external DIP switch for interrupt priority.
- +5.00 VDC at 0.7 amps

## Connector Distribution Board

The connector distribution board provides a convenient termination interface for the distributed interface boards in the machine to the microprocessor. It carries the following connectors for the interface functions:

| Description | Function |
|---|---|
| P21 - D 9 pin plug | RF Amplifier |
| J22 - D 9 pin socket | Thermistors |
| P23 - D 25 pin plug | Injector pump |
| P24 - D 37 pin plug | Control panel |
| P25 - D 15 pin plug | Pneumatics |
| J26 - D 15 pin socket | Throttle Valve |
| P27 - D 9 pin plug | AC interface |
| P28 - Molex 9 pin plug | Printer power |

## Power Supplies

The two power supplies for the control system are housed in the control enclosure. The first supply is a triple output 80 W switching type with the following outputs:

| Voltage | Current |
|---|---|
| +5.2V | 8 Amps (2 Amps Min.) |
| +12V (reg) | 1.2 Amps |
| -12V | 0.5 Amps |
| +12V (unreg) | 2 Amps (5 Amps peak) |

The second power supply, which is used for the throttle valve stepper motor, printer, and cassette drive motor, is a single output switching type: +12.85V at 6.5 Amps.

# User Interface Calibration

**IMPORTANT!**: Your first step when servicing a system is to verify that the system is properly connected to the power source, and to make sure all the subsystems are properly connected to the AC system and all circuit breakers are on and functioning normally. Once you have verified these things, proceed with your calibration steps.

The user interface, consisting of (for the purposes of this manual) the software settings, membrane switch and the printer should be calibrated when any component is replaced, when there is a malfunction or when product certification shows faults in the system.

## *User Interface Calibration Topics:*

- Setting the Printer DIP Switches
- Setting the Audible Alarm
- Setting the LCD Contrast
- STERRAD 100 S System Settings
- Setting System Parameters
- Setting the System Clock
- Setting the System Serial Number and Total Machine Cycles
- Master Reset

# Setting the Printer DIP Switches

The diagrams below show the DIP switch settings for Block 1.8.

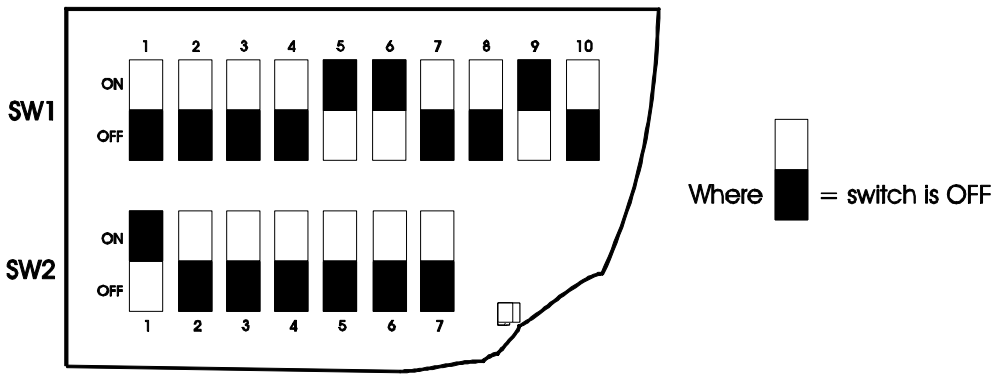


***Figure 6-2. DIP Switch Settings***

Block 2.

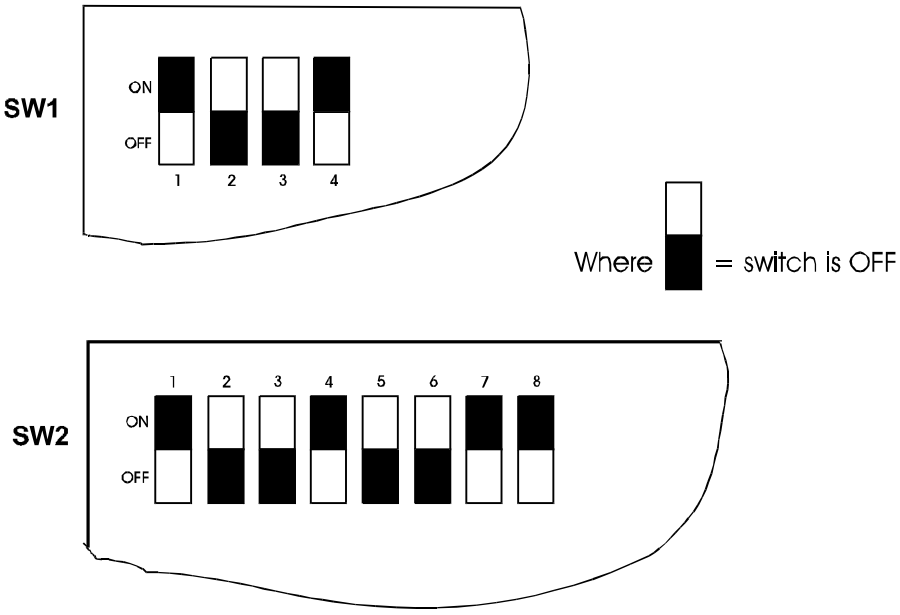


***Figure 6-3. Block 2 DIP Switch Settings***

# Setting the Audible Alarm

Block 2 systems allow for setting the volume of the audible alarm. The switch is on membrane control PCB at the back of the membrane switch panel.

1. Turn the bottom blue switch (R4) clockwise to increase volume and counter-clockwise to decrease.

# Setting the LCD Contrast

All systems allow your to set the LCD display contrast. The switch is on the membrane control PCB at the back of the membrane switch panel.

1. Turn the top blue switch (R1) clockwise to increase volume and counter-clockwise to decrease.

# Setting System Parameters

System parameters or defaults are those settings that keep track of system activities. System activities are regularly included in the messages printed by the system. They are:

- STERRAD 100 S System Settings
- Setting the System Serial Number and Total Machine Cycles
- Setting the System Clock
- Master Reset

## *STERRAD 100 S System Settings*

**Caution: If power is off for more than 1 minute, the system goes to the Cancel/Abort processing as soon as power is restored, and the printout indicates that the cycle did not complete properly. If power is off for less than 1 minute, however, the door closes and the cycle continues when power is restored; the printout does not indicate that there is a problem. Results from any cycle in which the door opened during the sterilization process should be considered invalid, and the load should not be considered sterile.**

### Cycle Parameters

**SHORT CYCLE** (default)
Editor selections: Long Cycle = NO
*Elapsed Time = 55 minutes, Double injection*

**LONG CYCLE**
Editor selections: Long Cycle = YES
*Elapsed Time = 72 minutes, Double injection*

Upon installation, the cycle defaults to **SHORT CYCLE**. If this is not changed in the editor, pressing **START** while the system is idle give you a confirmation of that cycle. Pressing **CANCEL** changes the choice to a different cycle. Once a different cycle has been selected in the editor, the choice remains in effect until changed, or until the Total Machine Cycles are reset to 0 (this sets the cycle to the default).

## *Enter the Edit Mode-STERRAD 100 S Systems*

1. To enter the EDIT mode, press **CANCEL.**

2. Press and hold **CANCEL** and simultaneously press **START**. This opens the Date-Time menu.

   **DATE = DAT MM/DD/YY**
   **OPEN(chng)- CLOSE(accept)**

3. Simultaneously, press **START** and **OPEN DOOR** for 5 seconds to view and edit the process parameters. The system displays the serial number with a flashing cursor in the serial number field. Setting the serial number is shown in the following procedure.

   **SERIAL NUMBER 0**
   **OPEN (chng)- CLOSE(accept)**

4. Press **CANCEL** to move sequentially through the available menus.

## *Setting the Total Machine Cycles-STERRAD 100 S Systems*

1. Note the total machine cycles and the serial number.

2. Press CLOSE DOOR about 4 times to move the cursor to the 5th digit field.

3. Press CANCEL to change the fields. The total machine cycles should be displayed. The total machine cycles menu looks like this:

   **TOTAL MACH. CYCLES XXXXX**
   **OPEN(chng) - CLOSE(accept)**

   XXXXX represents the total machine cycles run.

4. Press **OPEN DOOR** until a 6 is displayed. (The numbers in the other fields are not important for this procedure.)

5. Press **OPEN DOOR** once more and the system resets to 0. The serial number is also reset at this time.

6. Press **OPEN DOOR** enough times to change the first digit of the machine cycles back to the number noted in Step 1.

7. Press **CLOSE DOOR** to move the cursor to the left. Press **OPEN DOOR** to set the next digit. Continue pressing **CLOSE DOOR** to move the cursor and **OPEN DOOR** to set the digits to correspond to the machine cycles noted in Step 1.

8. Press **CANCEL** to change the fields. The Clock Mode is displayed.

## *Setting the Clock Mode-STERRAD 100 S Systems*

1. Press **CANCEL** to display the following

   **CLOCK MODE XX**
   **OPEN(chng)-CLOSE(accept)**

   XX is the mode of the clock (12 hour time or 24 hour time).

2. Press **OPEN** to toggle the clock mode to a desired setting. This setting affects all printed time notations.

3. Press **CLOSE** or **CANCEL** to go to the Cycle Type menu. If you not setting the cycle type, press **CANCEL** twice to enter the Serial Number Menu

## *Setting the Serial Number- STERRAD 100 S Systems*

The serial number menu looks like this:

**SERIAL NUMBER XXXXXX**
**OPEN(chng) - CLOSE(accept)**

XXXXXX represents the machine serial number; it can be any number from 0 through 999999.

1. Press **OPEN DOOR** enough times to change the first digit of the serial number.

2. Press **CLOSE DOOR** to move the cursor to the left. Press **OPEN DOOR** to set the next digit. Continue pressing **CLOSE DOOR** to move the cursor and **OPEN DOOR** to set the digits to correspond to the machine serial number located on the frame behind the storage drawer.

3. When you have set the serial number, press **CLOSE DOO**R so that you do not accidentally change the number.

4. Simultaneously press **START** and **OPEN DOOR** (the display switches to the edit date/time menu). Then simultaneously press START and **CANCEL** to return to the active display.

## *Setting the Cycle Type - STERRAD 100 S Systems*

*Note: The Cycle Type menu actually appears after the Clock Mode Menu.*

1. From the Serial Number menu, press CANCEL three times to display the Cycle Type menu. The first 2 times the Total Machine Cycles and the Clock Mode menu display in sequence. The third time CANCEL is pressed, the Cycle Type menu displays as follows:

```
LONG CYCLE =      NO
OPEN(chng)-CLOSE(accept)
```

2. Press **OPEN** to toggle the Long Cycle selection between YES and NO.

## *Exiting the Editor and Starting a Cycle-STERRAD 100 S Systems*

1. Press **START** and **OPEN** simultaneously for 2 seconds to exit from the Editor. The Date section of the Time/Date Editor is displayed.

```
DATE = DAY MM/DD/YY
OPEN(chng)-CLOSE(accept)
```

2. Press **START** and **CANCEL** simultaneously for approximately 1 second to exit from the Date/Time editor. The LCD displays one of several informational messages, such as:

- READY TO USE
- INSERT NEW CASSETTE (if there is no cassette in the sterilizer.)
- MAINTENANCE DUE (if the system is nearing a PM interval.)
- REPLACE USED CASSETTE COLLECTION BOX (if the cassette box contains the maximum number of used cassette.)

3. To start a sterilization cycle, confirm that a cassette has been accepted by the system, and press **START**.

4. If the system displays the message WARMING UP...PLEASE WAIT after pressing **START,** wait until the LCD displays READY TO USE, then press **START** again. The cycle determined by the selections made in the editor is initiated.

### *Parameter Printout- STERRAD 100 S Systems*

1. When you exit the editor from the **CYCLE TYPE** menu by pressing **START** and **OPEN DOOR**, the values of the parameters are stored in the printer buffer.

2. When you exit the editor from the SERIAL NUMBER menu, the serial number, software date, part number revision level and checksum are sent to the printer buffer.

3. When the operation is complete, and the system is in idle mode, the printer buffer prints its information in the following format

```
DAY MM/DD/YY HH:MM:SS (prints in red)
SERIAL NUMBER = 999999
MM-DD-YY VEN XXXX  YYYY
04-04224-0-001-3   CS=ZZZZ
```

*Note: MM-DD-YY is the build date of the software.XXXX is the language-section Check Sum.YYYY is the code-section Check Sum. ZZZZ is the total Check Sum (XXXX + YYYY)*

### *Identification-STERRAD 100 S Systems*

1. The software initializes the LCD at the power up and also when exiting from the EDIT mode. If a good cassette is in the injector pump the following message is displayed:

```
MM-DD-YY LLLLLL
04-04224-0-001-3 CS=XXXX
```

LLLLLL represents the language in use, in this case English, and 00X denotes the language part number.

*Note: LLLLLL = ENGLIS. X = 1 (English). MM, DD, YY and CS=XXXX are described in the previous note.*

# Setting the System Clock

1. Enter the edit mode by pressing **START** and **CANCEL** at the same time. The LCD display shows the following:

```
DATE = DAY,      MM/DD/YY
OPEN(change) - CLOSE (accept)
```

2. DAY is a three letter abbreviation for the day of the week e.g., WED; MM is the month, e.g., 03; DD is the numerical day, e.g., 25; and YY is the year, e.g., 95. A flashing cursor is displayed on the DAY field.

3. To change the displayed day, press **OPEN DOOR** until the desired day is selected. When the correct day is displayed, press **CLOSE DOOR** to move to the month MM field.

4. Press **OPEN DOOR** to change the MM, DD, and YY each in turn until the desired setting is displayed. Press CLOSE DOOR each time to move the cursor to the next field. After the YY is updated, the following message is displayed on the LCD:

   **TIME=HH:MM:SS AM**
   **OPEN(change) - CLOSE (accept)**

   HH is the hour of the day, e.g., 09; MM is the minutes, e.g., 12; SS is the seconds, e.g., 43; AM represents after (12:00 a.m.) midnight and PM represents after (12:00 p.m.) noon.

5. Press **OPEN DOOR** to change the HH, MM, and SS each in turn until the desired setting is displayed. Press **CLOSE DOOR** each time to move the cursor to the next field. After the AM/PM field is updated, the current date is displayed.

6. After the desired date and time settings have been obtained, simultaneously press **START** and **CANCEL** to exit the month/time program.

# Setting the System Serial Number and Total Machine Cycles

1. Note the total machine cycles and the serial number.

2. Press **START** and **CANCEL** at the same time; this displays the edit mode. Then press **START** and **OPEN DOOR** for five seconds. The system displays the serial number with a flashing cursor in the serial number field.

3. Press **CLOSE DOOR** about 4 times to move the cursor to the 5th digit field.

4. Press **OPEN DOOR** until the 6 is displayed. (The numbers in the other fields are not important for this procedure.) Press **OPEN DOOR** once more and the system resets to 0. The serial number is also reset at this time.

5. Press **OPEN DOOR** enough times to change the first digit of the machine cycles back to the number noted in Step 1.

6. Press **CLOSE DOOR** to move the cursor to the left. Press **OPEN DOOR** to set the next digit. Continue pressing **CLOSE DOOR** to move the cursor and **OPEN DOOR** to set the digits to correspond to the machine cycles noted in Step 1.

7. Press **CANCEL** to change the fields. The serial number fields should be displayed.

8. Use **OPEN DOOR** and **CLOSE DOOR** in the same way as shown in steps 5 and 6 to set the serial number.

9. When you have set the serial number, press **CLOSE DOOR** so that you do not accidentally change the number

10. Simultaneously press **START** and **OPEN DOOR** (the display switches to the edit date/time display). Then simultaneously press START and **CANCEL** to return to the active display.

# Master Reset

1. Defeat the safety interlock, remove the service test (Autotest) PCB (if installed), and install the system microprocessor PCB.

2. Apply power to the enclosure by enabling the safety interlock and pressing CANCEL simultaneously.

3. Continue to hold CANCEL until you hear the beep signal, then release.

4. Remove the cassette collection box. Wait for the beep tone and then reinstall the empty box.

# Controller Calibration

The AC and controller subsystem should be calibrated whenever either subsystem is replaced, there is a malfunction or when the product certification procedures show a fault to be corrected.

IMPORTANT!: Your first step when troubleshooting a system is to verify that the system is properly connected to the power source, and to make sure all the subsystems are properly connected to the AC system and all circuit breakers are on and functioning normally. Once you have verified these things, proceed with your product servicing.

### *Calibration Topics*

- Power Supply Adjustment
- Analog To Digital (Set Point)
- High/Low Pressure Range Divider Voltage

## Power Supply Adjustment

**WARNING! Use a non-conductive tool to make all power supply adjustments. Wear a static strap.**

***Note:*** *Adjustments to the power supply voltages may affect the A/D set point and temperature calibrations. Be certain to check these settings after any voltage adjustment or power supply replacement.*

The power supplies in the control enclosure are similar in appearance with the 12 volt supply located closest to the side of the system. The 5 volt supply is located directly behind the 12 volt supply. Be sure you use the small test leads on the Block 2 power supplies. If the adjustments are not done correctly you can short out the power supply. The following 5 steps all have information on the Block 2 configuration.

1. Remove the system panels. Open the control enclosure and apply power to the enclosure using the safety interlock. Locate the connector distribution board TB1 (terminal block 1). On Block 2 devices, locate the connector distribution connector J121 (TB1). The diagrams below show the adjustments for Block 2 (top diagram) and Block 1.8 (bottom diagram)

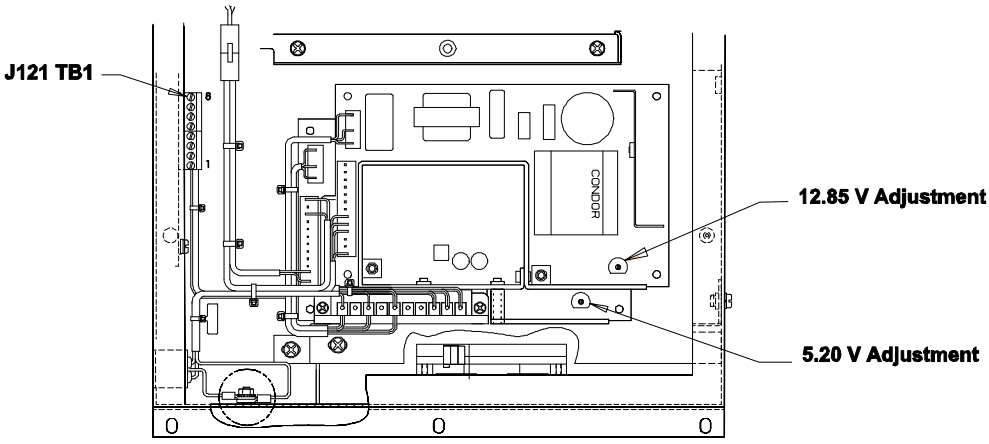


*Figure 6-4. Block 2 Power Supply Adjustments*

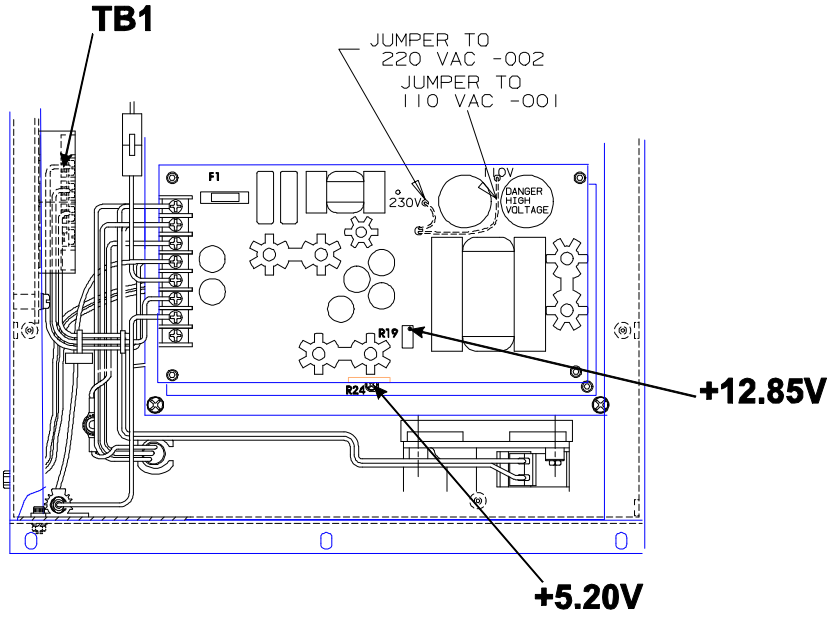


*Figure 6-5. Block 1 Power Supply Adjustments*

2. Connect a DVM between the ground (terminal #1) which is closest to the connector distribution board edge, and the +12 Volts, Terminal #3. On Block 2 devices connect a DVM between the ground (pin #8 at the top of J121) and +12V (pin #3).

3. Adjust the 12 volt power supply to 12.85 volts, 0.05 volts with the voltage adjust trim pot located in the lower center area of the 12 volt power supply board. On Block 2 devices the trim pot is located in the lower right area of the 12 V power supply board.

4. Connect a DVM between the ground (terminal #1) closest to the connector distribution board edge, and the +5 V, terminal #2. On Block 2 devices connect the DVM between the ground (pin #8 at the top of J121) and pin #5.

5. Adjust the 5 V power supply to 5.2 volts symbol 177 \f "Symbol" \s 10±0.02 volts with the voltage adjustment trim pot located on the lower center of the 5 V power supply board. On Block 2 devices the trim pot is located on the lower right of the 5 V power supply. Close the enclosure or proceed to the Analog-to-Digital Set PointAnalog_To_Digital_Set_Point calibration.

# Analog To Digital (Set Point)

**CAUTION: Some Block 1.8 systems have Block 2 style PWAs. Be sure to use the correct leads to avoid shorting out the power supply.**

1. Remove the system panels. Open the control enclosure and interrupt power to the enclosure by using the safety interlock.

2. This step is for 1.8 systems without an upgraded board. Remove the analog to digital (A/D) board, and install a 40 pin IC test clip on IC-8. Install an extender board in the A/D board slot and plug the A/D board into the extender. Apply power to the enclosure by enabling the safety interlock, and allow 15 minutes for the system to stabilize.

3. Measure the voltage between IC-8 pin 39, and IC-8 pin 36. Adjust trim pot R1 on the A/D board for 2.048 VDC ± 0.005 VDC. Apply a small amount of Glyptal to the trim pot to lock adjustment.

4. For Block 2 devices (and updated 1.8 systems), measure the voltage between test point 1 (+) and test point 2 (-). Adjust trim pot R1 on the A/D board for 2.048 VDC ±0.005 VDC (counterclockwise to increase, clockwise to decrease). Apply a small amount of Glyptal to the trim pot to lock adjustment.

5. Interrupt power using the safety interlock, remove the extender board, remove the IC test clip, and reinstall the A/D board in the control enclosure. Apply power to the enclosure by enabling the safety interlock. Close the enclosure unless you are testing the high/low pressure range divider voltage.

*Note: Adjustment to the A/D set point may affect the chamber and door temperature calibrations. Verify the temperature settings after adjusting the A/D set point. The A/D set point should be verified after any power supply voltage adjustment, or power supply replacement.*

## High/Low Pressure Range Divider Voltage

**CAUTION: Be sure to use the correct leads on Block 2 systems to avoid shorting out the power supply.**

1. Open the control enclosure and interrupt power to the enclosure using the safety interlock. Remove the microprocessor board, and insert the AutoTest board.
2. Remove the connector from the Baratron pressure transducer, and attach the voltage divider adjustment tool to the harness connector.
3. Apply power to the enclosure using the safety interlock.
4. Perform the Analog Test.
5. At the completion of the test, interrupt power using the safety interlock, remove the AutoTest board and install the system microprocessor board. Remove the adjustment tool and reconnect the cable to the pressure transducer. Apply power to enclosure using the safety interlock. Close the enclosure.

# User Subsystem Replacement Procedures

## Remove/Replace the Printer

1. Unplug the ribbon cable. Remove the paper roll.
2. Unscrew the two screws holding the printer to the frame.
3. Lift up on the printer to remove it.
4. Replace the printer by tipping it into place and replacing the screws.
5. Plug in the ribbon cable. Replace the paper roll.

# Remove/Replace the Printer (Block 2)

1. Turn off the system power and pull out the printer drawer.
2. Detach the paper from the take-up roll and then from the printer.
3. Remove the printer ribbon cartridge.
4. Remove the top two Phillips screws and set them aside.
5. Loosen, but do not remove the bottom two Phillips screws.
6. Disconnect the printer cable and then slightly lift up on the printer and remove it.
7. Set the new printer in place making sure the bottom end fits behind the screw head and washers. Reconnect the printer cable.
8. Replace the top screws and tighten. Then tighten the bottom screws.
9. Replace the printer ribbon cartridge.
10. Turn on system power and feed both copies of the paper through the printer from the bottom. Press PAPER ADVANCE to feed out about 8-10 inches of paper.
11. With the gear at the left, thread the yellow paper onto the take-up reel. (A straight edge helps.)
12. Place the take up reel in the slots holding it and press PAPER ADVANCE so that the take up reel turns and tightens the paper.
13. Feed the white copy through the slot in the drawer and close the drawer.
14. Press CANCEL and START simultaneously to print a test message.

# Remove/Replace the Membrane Switch

1. Unscrew the 4 screws holding the membrane switch to the bezel.
2. Pull gently and the membrane switch will release from the bezel.

3. On Block 2 devices press down on the tabs holding the membrane switch to the bezel. The membrane then pulls away easily from the bezel.
4. To replace the membrane switch, press it into place and replace the screws or, on Block 2 devices, make sure it snaps into place.

# Control Subsystem Replacement

The removal and replacement procedures below show how to remove the control enclosures. The boards, and power supplies, are field replaceable units. The boards are removed by pulling them out from the card cage. as shown in the diagram below.

## Remove the Control Enclosure

1. Remove the system panels. Unplug the control harnesses leading to the printer, RF generator, the thermistors, the injector, the user interface, the pneumatics system, the vacuum throttle valve and the AC interface.
2. Unplug the unit from the AC power.
3. Unplug the CPU, analog and digital I/O boards from the enclosure and set them aside in a static safe area.
4. Unscrew the control enclosure from the frame and remove it from the system.

***Note**: The Block 2 control enclosure is slightly different looking, on the inside, from the Block 1.8.*

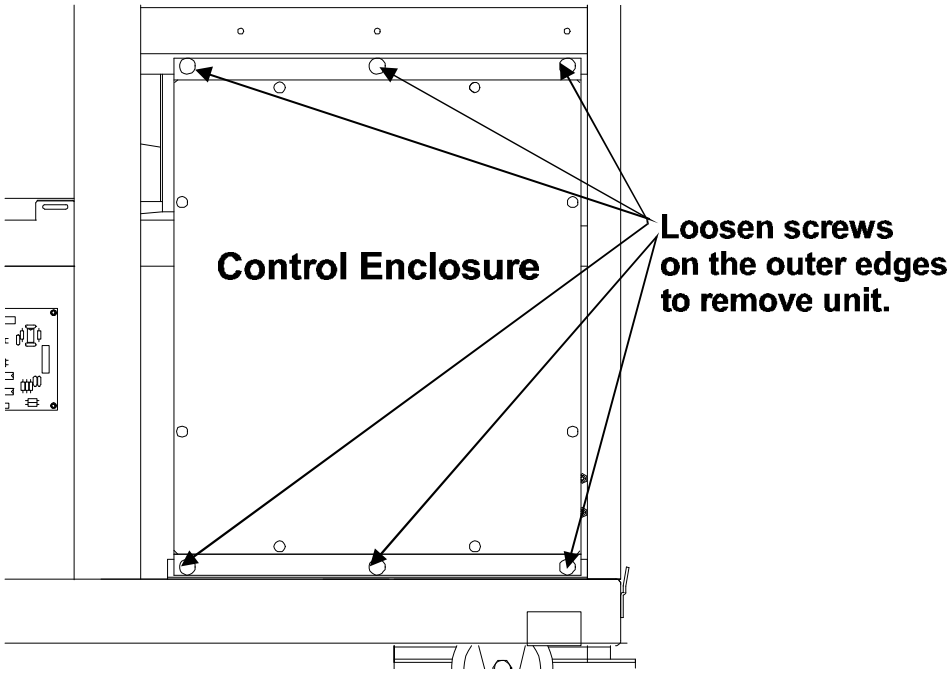


***Figure 6-6. Control Enclosure***

# Replace the Control Enclosure

1. Attach the control enclosure to the frame.
2. Plug in the control harnesses from the subsystems as labeled on the enclosure.
3. Install the circuit boards removed from the old enclosure into the new enclosure.
4. Plug in the AC power.

# Remove the Power Supplies

The Block 2 procedures are slightly different and are included in the steps below.

1. Open the control enclosure side panel.
2. Remove the 4 nuts fastening the 12.85 V power supply On Block 2 remove the 4 screws mounting the power supply assembly.
3. Remove the standoffs from the 5 V power supply. (Not present on Block 2.)
4. Remove wires from terminal block. (Block 2. Unfasten the power supply connections.)

# Replace the Power Supplies

1. Fasten the wires to the terminal block. (Block 2. Reconnect the power supply).·

**CAUTION** **Be sure you connect the wires correctly. See the block 1.8 wiring diagram on the following page for information.**

2. Reattach the power supplies using the standoffs (Block 1.8, 5 V), or the 4 nuts (Block 1.8 12 V) or the 4 screws (Block 2)
3. Replace the control enclosure side panel.

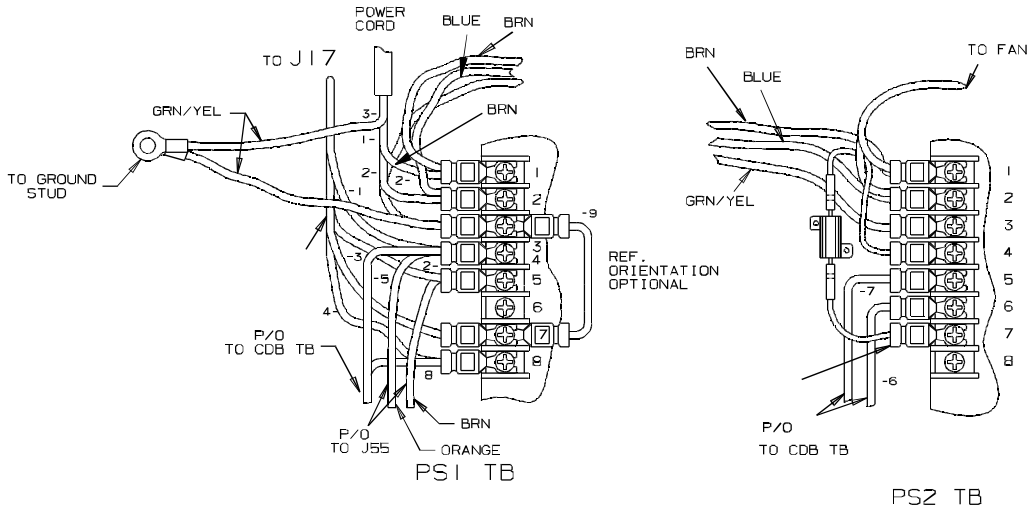


*Figure 6-7. Power Supply Wiring*

# Remove/Replace the Firmware

**CAUTION! STATIC SENSITIVE DEVICES. You must use a static strap and have a static controlled area available when performing this procedure.**

1. Examine the last cycle printout. Note the total machine cycles.
2. Press **START** and **CANCEL** at the same time. The system displays the current date.
3. Press **CANCEL** twice. Verify that the total machine cycles (next to the NEXT PM field) are the same as the printout.
4. Turn main power circuit breaker OFF.
5. Remove the control enclosure panel.
6. Remove the existing microprocessor board and place it on a static controlled work area. Remove the exiting EPROM from the board and install the replacement firmware. Pay close attention to the orientation of the chip.
7. Replace the microprocessor board.
8. Turn the main power circuit breaker to ON.
9. Perform a Master Reset.

10. Verify that the software parameters are displayed on the LCD. These parameters include the month and year, the words STERRAD 100 and the software part number and CS number. The parameters change with each software release.

11. Remove the firmware if the parameters are not verified. Discard the incorrect EPROM and repeat with a new EPROM

12. Enter the EDIT mode and set the correct time, date, serial number, and total machine cycles as previously shown in the calibration section.

# Chapter 7

# *Door and Chamber Subsystem*

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# Introduction

This section details the door and chamber subsystems. Included in this chapter are the theory of operation as it relates to the door and chamber, the tools needed for door and chamber maintenance; calibration, including guide rail alignment; also removal and replacement of the door, electrode, sight glass; certification of the door and chamber temperatures.

## Different Door and Chamber Configurations

The STERRAD® 100 system is currently in the **Block 2.0** and STERRAD **100 S** System phase. These versions are only slightly different, with regard to the "look" of the door, from previous versions of the STERRAD 100 System. The chamber has slight variations as to the placement of some components on its exterior: The heaters are different, and in different locations on the **Block 2** systems. Some of the tests have slight variations to accommodate the multiple injection stages of the STERRAD **100 S** Software cycle.

Differences in configurations are noted in the text. When you see the STERRAD Icon next to the text, as with this paragraph, that is the symbol for a configuration other than Block 1.8.

## Door and Chamber Subsystem Descriptions

The chamber (also known as the process chamber) is a cylinder, closed on three sides and sealed by a door during the sterilization cycle. Within the chamber, concentric with the chamber wall, is the electrode screen, which, when excited by the RF subsystem, helps to create the plasma during the plasma stage of the cycle.

The door is activated by means of a pneumatic cylinder and is operated by the touch buttons on the user interface. The door moves vertically and several sensors monitor its travel and activate error messages to alert the user to problems. The door has no window (and is very heavy), though it can be pushed downward by hand if there is no vacuum in the chamber.

# Door and Chamber Theory of Operation

## Chamber Subsystem

The chamber is connected to the vacuum subsystem through an aperture at the bottom rear of the chamber. Through this aperture the chamber is pumped down during the vacuum stage, and filtered ambient air is admitted to it during the vent stage.

The patented injector valve assembly, containing the needle and vaporizer assemblies, is mounted through the top front boss of the chamber.

At the bottom middle of the electrode screen is the feedthrough copper shaft connecting the electrode screen inside the chamber to the RF match module.

## Door Subsystem

The door moves vertically at a speed of 200 mm/sec ±5 mm/sec. and is actuated by means of a pneumatic cylinder. If a vacuum is present, the vacuum helps hold the door closed. If the power fails during a cycle, and is not reapplied, the door can remain closed for up to several days until the normal, minimal leakage returns the chamber to atmospheric pressure. If power is reapplied and the chamber vented, the door can be opened. If no vacuum is present, the door opens automatically at power failure.

If the power failure has a duration of less than 1 minute, and occurs in the vacuum stage, the period between 10 and 48 minutes of the diffusion phase, or the vent stage, the cycle continues normally. Otherwise, whenever the power is restored, the software computes where in the cycle it was when the power failed, and enters the correct abort cycle. During the process, the door remains closed.

### Operation

- Door operation is controlled by the touch sensitive push buttons: **START, OPEN DOOR, CLOSE DOOR**, and **CANCEL**.
- The operator closes the door (opens the door) using **CLOSE DOOR (OPEN DOOR**).
- Pressing **START** begins the process by closing the door if it is open, and continues through a complete sterilizing cycle.

- If the operator presses **CANCEL** at any time during the sterilization cycle, or if the control subsystem detects a malfunction, the door automatically opens after the current stage has been safely terminated. The operator cannot open the door using **OPEN DOOR** during the sterilization cycle.

The door sealing the process chamber during the sterilization cycle is moved up and down on guide rails, by a cable driven by a pneumatic cylinder. This cylinder is controlled by a 4 way solenoid valve, actuated by signals from the control subsystem. The cylinder raises the door to its locked operating position, or lowers the door slowly to its rest position. The door's weight is balanced by a counterweight.

Three sensors send signals to the control subsystem for door control. These sensors mark top and bottom door positions, and the position at which the door seals the process chamber.

✔ ***Note****: The adjustment and function of the three door sensors are critical for correct sterilizer operation.*

The bottom sensor indicates the door is fully open and any command to close the door is valid. The top sensor detects that the door has reached the upper travel limit. The over-center sensor detects movement of the door over-center mechanism. This movement is indicative of two possible situations:

- If the over-center sensor is activated before the top sensor, due to the door being blocked before reaching the end of its travel, the door reverses direction and opens immediately.
- If the door over-center sensor is activated after the top sensor, the door has closed completely and correctly. Evacuation of the chamber can proceed.

# Calibration

**IMPORTANT!:** Your first step when calibrating a system is to verify that the system is properly connected to the power source, and to make sure all the subsystems are properly connected to the AC system and all circuit breakers are on and functioning normally. Once you have verified these things, proceed with your calibration steps.

## Door and Chamber Temperature

✔ *Note: Assure the system has had power applied for at least 45 minutes.*

1. Remove the system panels. Begin an empty chamber cycle.

✔ ***Note:*** *On STERRAD 100 S Systems, perform the steps below during the second injection stage, not the diffusion stage.*

2. During the diffusion stage, use a Fluke model 80T-150U, or equivalent, to measure the door temperature at the back surface of the door in the lower right corner (when viewed from the front), 40 mm in from the edges.

3. During the diffusion stage, adjust the door temperature for a reading of 46° C ±2°C using the top trim pot (R5) on the connector distribution PCB. Clockwise rotation increases temperature about 0.5°C per turn.

4. With a Fluke model 80T-150U, or equivalent, measure the chamber temperature adjacent to the thermistor located by the chamber rib.

5. During the diffusion stage, adjust the chamber temperature for a reading of 46°C ±2°C using the center trim pot (R6) on the connector distribution PCB. Clockwise rotation increases temperature about 0.5°C per turn.

6. Initiate a second empty chamber cycle and verify that the door and chamber temperatures meet specification. Repeat this section if necessary.

## *Door/Chamber Temperature (Block 2)*

1. Remove the system panels. Begin an empty chamber cycle. Make sure the top, back, front and one side panel are in place to achieve a true temperature profile.

2. Check the voltage at chamber heater connector P115. It should read 208 ±10%VAC. Check the voltage at door heater connectors P95. It should read 208 VAC. (These are nominal readings only to check shorts and opens).

✔ ***Note****: Block 2 has 4 J-type thermocouples connectors. T/C 1 and T/C 2 are located at the right rear of the frame near the chamber. T/C 3 and T/C 4 are located on the lower right of the door.*

✔ ***Note:*** *On STERRAD 100 S Systems, perform the steps below during the second injection stage, not the diffusion stage.*

3. Connect an Omega thermocouple tester (J-type) to T/C 1. Verify that the temperature measured during the diffusion stage is 42º - 50º C. Repeat for all 4 thermocouples listed in the note above.

4. Using T/C 2 adjust the chamber temperature to read 42º - 50º C using the center trim pot (R3) on the connector distribution PCB. Rotate the trim pot clockwise one turn to increase temperature; about 0.5°C per turn.

5. Using T/C 4, adjust the door temperature to read 42º - 50º C using the top trim pot (R4) on the connector distribution PCB. Rotate the trim pot clockwise one turn to increase temperature; about 0.5°C per turn.

6. Initiate a second empty chamber cycle and verify that the door and chamber temperatures meet specification. Repeat this section if necessary.

# Door Top, Bottom, And Over Center Sensors

1. Remove power to system. Remove the system panels. Disconnect and mark the air lines to the door cylinder so it can be manually operated.
2. Manually move the door to the top (not the over center) position and verify that the door flag just blocks the optical path of top sensor.
3. Adjust the flag (mounted on door) as necessary to achieve vertical positioning within the door sensor PCB optical path.
4. Adjust the sensor PCB bracket (mounted on the guide rail) as necessary to ensure the flag passes well into the light path, but does not hit the sensor PCB.
5. Verify that the flag passes midway between the optical devices located on the sensor PCB. Adjust sensor PCB as necessary.
6. Manually move the door to the bottom (not the service stop) position and verify the door flag blocks the optical path of the bottom sensor.
7. Repeat previous adjustment steps for bottom sensor alignment.

   ✔ ***Note**: There is only one door flag used for both top and bottom sensors. Adjusting this device for bottom position affects the previously set top position. Recheck top sensor if the flag must be moved.*

8. Move the over center flag up until the optical path is just blocked, then lower the flag approximately 2.0 mm.
9. Verify that the flag passes midway between the optical devices. Adjust sensor PCB as necessary.
10. With no pressure applied to the door over center mechanism, verify the door over center flag does not block the sensor.
11. Reconnect air lines to door cylinder and check door operation with normal firmware. Ensure that the door over center mechanism is functioning properly by blocking door and observing the reversing action.

    ✔ ***Note**: The door over center mechanism should actuate with approximately five pounds (2.5 kilos) of pressure applied to the top of the door.*

# Door Open Close Speed

1. Remove the system panels. Verify that the air pressure is set correctly to cut-in at 60 PSI, and to cut-out at 80 PSI.
2. Loosen the speed control valve locking nut on the control valve located on the exhaust (lower) side of the door cylinder.

3. Adjust the speed control valve to close the door in approximately 5 seconds. Secure the locking nut.

4. Loosen the speed control valve locking nut on the control valve located on the exhaust (upper) side of the door cylinder.

5. Adjust the speed control valve to open the door in approximately five seconds. Secure the locking nut.

### *Door Open and Close Speed (Block 2)*

1. Remove the system panels. Verify that the air pressure is set to cut-in at 60 PSI and to cut-out at 80 PSI.

2. Adjust the speed control valves on the valve assembly to fully open (counterclockwise). Then close them 3 full turns.

3. Operate the door to verify sealing of the chamber face.

4. Adjust the door open and close speeds with the speed control valves to that the door closes in approximately 5 seconds.

## Door and Chamber Alignment

Following are a number of procedures for aligning the chamber, frame, and door. Start with the first three steps here regardless of the alignment you are going to perform.

1. Remove the system panels. Open the paper storage drawer and find the service position lever. Lower the door to the service position.

2. Remove the chamber door O-ring.

3. Remove electrical power from the system. Mark the position of both air lines to the door cylinder and then disconnect.

### *Align Frame to Right Guide Rail*

1. Loosen, do not remove, all hardware securing right guide rail to frame and chamber.

2. Using gage T.2270 align the frame to the right guide rail by adjusting upper edge of guide rail at top panel bracket. See the diagram.

3. Tighten all hardware securing the right guide rail to the frame, leaving the chamber hardware loose.

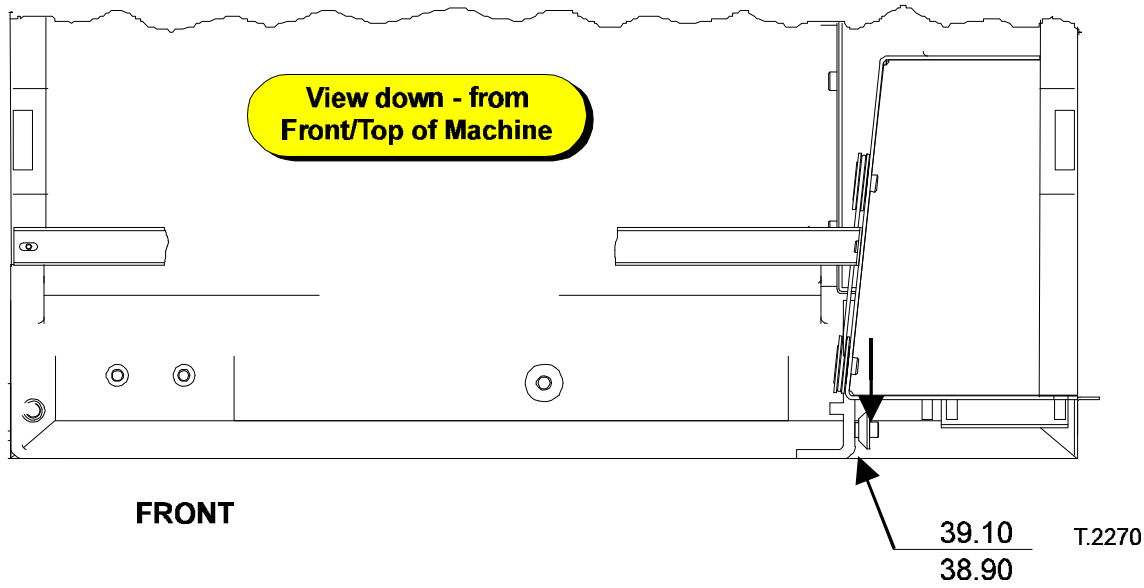


*Figure 7-1. Align Frame to Right Guide Rail*

## Align Chamber to Right Guide Rail

1. Remove the screw and cable from the right upper door stop bracket to give clearance for the gage.
2. Loosen, do not remove, the three mounting bolts securing the chamber to the right and left guide rail.
3. Using T.2266 align the chamber with the right guide rail. See the diagram. Adjust the chamber mounting eyebolt located at the rear of the chamber. This sets the chamber face parallel to the right guide rail, giving a slip fit.
4. Tighten the three bolts securing the right guide rail to the chamber.
5. Tighten the stand-off between the guide rail and the frame.
6. Using gage T.2266 verify that the alignment of the chamber and the right guide rail has not changed.

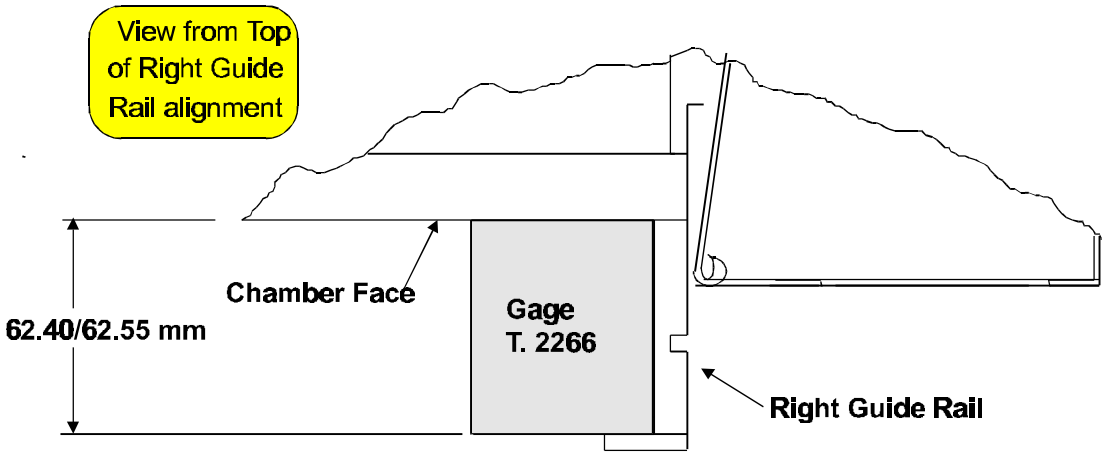


***Figure 7-2. Align chamber to Right Guide Rail***

## *Align Chamber To Left Guide Rail*

1. Assure that the left guide rail is flush with the frame front edge and secured with mounting hardware. Adjust if necessary.

2. Remove the screw and cable from the left upper door stop bracket to give clearance for gage T.2266.

3. Using gage T.2266 align the chamber to the left guide rail. See the diagram. Adjust the two horizontal mounting slots, located at the rear of the chamber. This sets the chamber face parallel to left guide rail, giving a slip fit.

4. Tighten the three bolts securing the left guide rail to chamber.

5. Using gage T.2266 verify that the alignment of the chamber and the left guide rail has not changed.

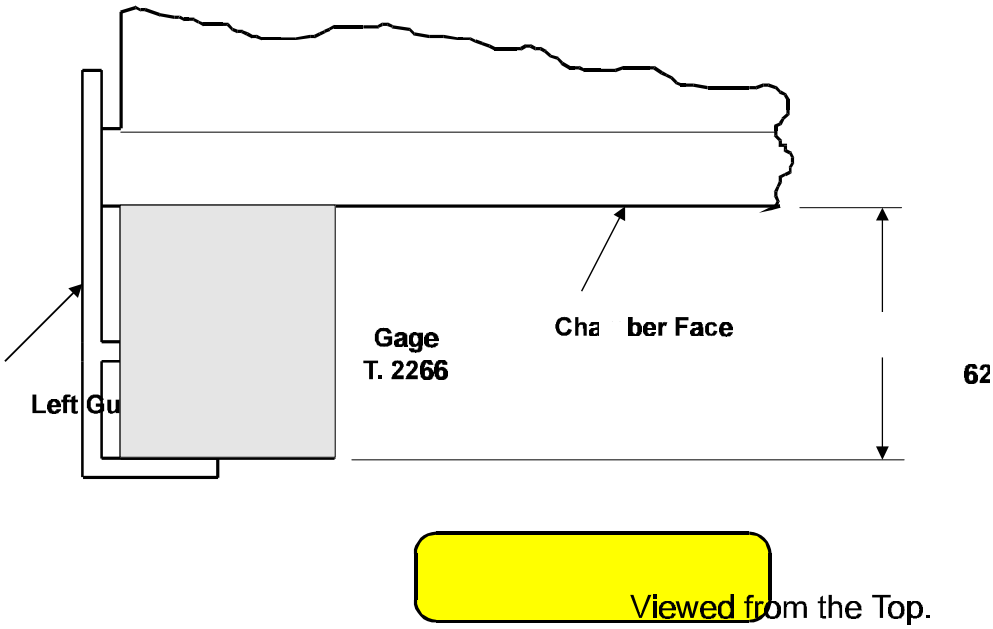


***Figure 7-3. Align Chamber to Left Guide Rail***

## *Align Left Guide Rail To Left Frame*

On Block 2 devices this alignment procedure is the same, however the gage is part of the frame assembly.

1. Using gage T.2270 adjust the back of the left guide rail to left frame upright at top panel bracket location. See the diagram.
2. Tighten all chamber mounting hardware (guide rails and eyebolt). Using gage T.2266 verify that the alignment of chamber and left/right guide rail has not changed.
3. Install the cables and screws at the left and right upper door stop brackets with the flat of the eye toward the center of the machine.
4. Secure with the M5 x 10.0 screws, lock washers and flat washers previously removed.
5. Secure the 3 panel brackets to maintain a dimension between 483 and 488 mm as measured between the inside edges of the right and left guide rails.
6. Reinstall the door seal O-ring.
7. If necessary, route the counterweight cable up and over the INNER groove of the upper right guide rail pulley, and over the OUTER groove of the counterweight pulley. On Block 2 systems skip this step. Misalignment is not a problem on Block 2 systems.

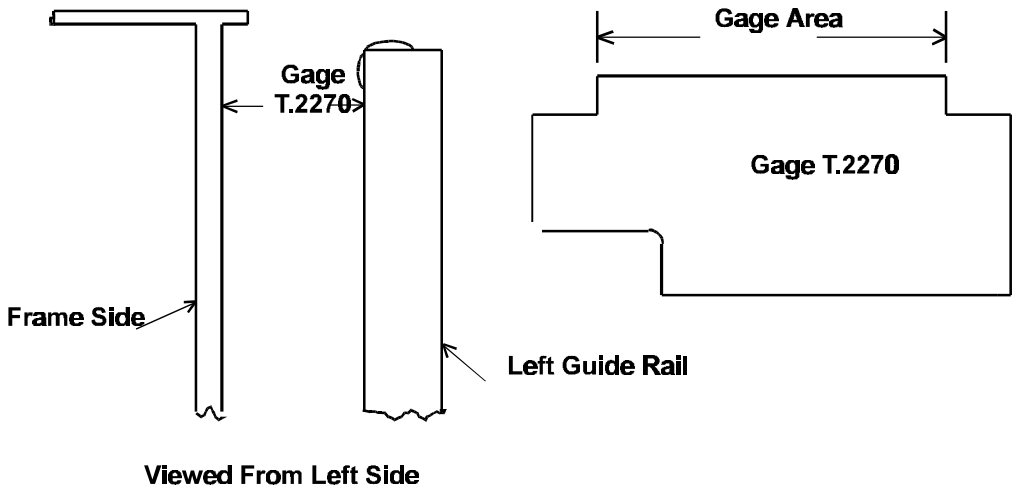


***Figure 7-4. Align Left Guide Rail to Frame***

8. Adjust and tension the door cables so that door hangs evenly and operates smoothly.

9. Adjust the cables to give 15 to 20 mm clearance at the air cylinder hex nut when the door is in the locked position. See the diagram.

10. Adjust both upper door stops to extend 21.5 mm (start position).

11. Adjust the door stops so that the door over center mechanism extends and closes the door against the O-ring evenly. View the air gap between the door and the chamber face from top and bottom to confirm correct alignment.

    ✔ ***Note:*** *The door links should be parallel to each other, and at horizontal or pointing slightly up at the rear.*

12. Reconnect the air lines to the door cylinder. Replace the front panel. Perform the alignment procedures for Door Top, Bottom, And Over Center Sensors.

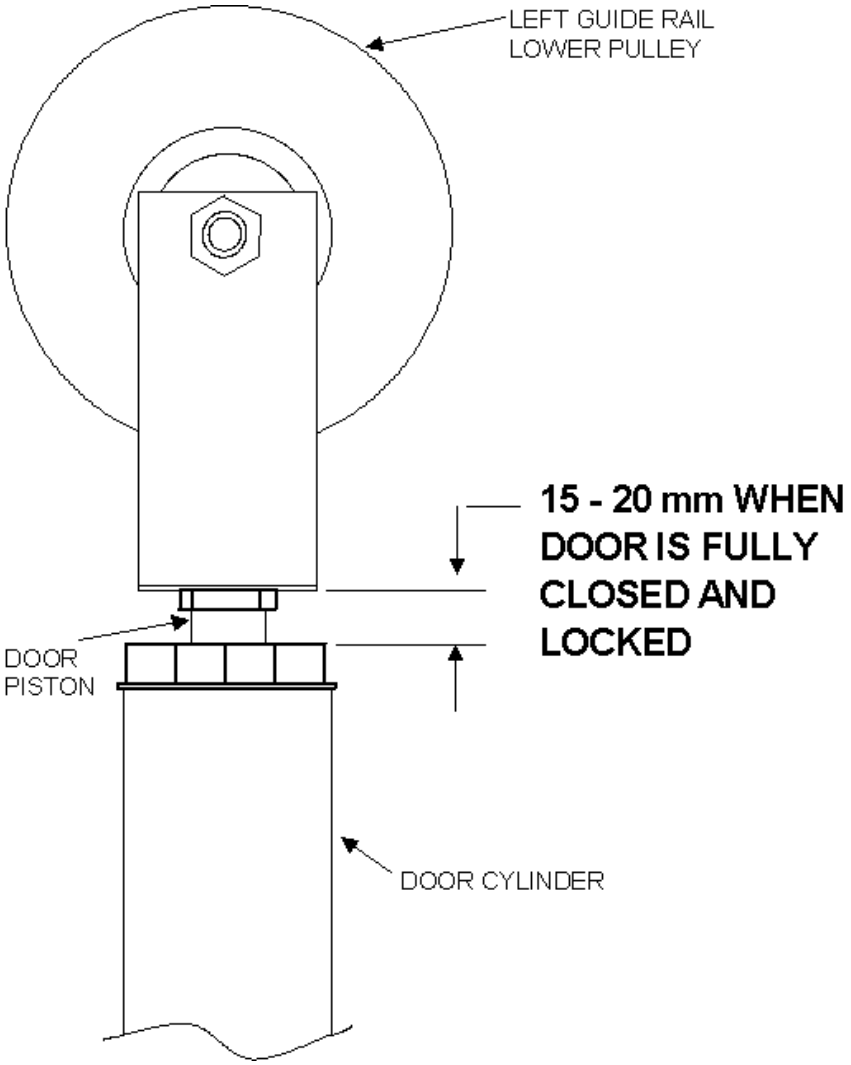


***Figure 7-5. Cable Adjustment***

## *Align the Chamber*

This procedure is not done routinely, it should only be done if needed as part of a door replacement, or if the chamber is out of alignment for another reason.

1. Loosen the brackets and gently move the chamber from side to side to bring it into alignment.
2. On Block 2, loosen the bracket at the side to move the chamber.

# Removal/Replacement

## Open The Door For Servicing

1. Open the storage drawer to reveal the right guard rail. Reach behind the open drawer and find the door stop lever.

2. Press **CLOSE DOOR**. When the door moves up, set the door stop lever down and press **OPEN DOOR**. The door opens to its service position, exposing the door O-ring that seals the chamber door, the rear surface of the door assembly and the chamber. See the diagram

## Remove the Electrode and Spacers

These steps contain the PM cleaning procedures.

1. Open the door for servicing  If performing a PM procedure inspect the back of the door and the chamber and clean if necessary (PM1). Clean the door, chamber and electrode routinely every year (PM2) using a Scotch-Brite type scrub pad and deionized water.

   ✔ ***Note:*** *The electrode can be steam cleaned if needed and if the customer location has this facility.*

2. Remove the door seal O-ring (see the following procedure).

3. Remove upper and lower shelves from the chamber.  The video shows the components to be removed.

4. Remove the Allen screw (located at the left, lower middle of the electrode) attaching the electrode to the chamber feedthrough.

5. Remove the screws (located at the front and middle of each upper shelf support) fastening the upper shelf supports to the electrode assembly. Slide the upper shelf supports towards the front of the system and remove them from the chamber.

6. Slide the upper left and right joiners towards the front of the system and remove them from the chamber.  Remove the front and rear shelf stops on the upper shelf and discard.

7. Slide the lower shelf supports towards the front of the system and remove them.

8. Remove the electrode from the chamber. Discard the 18 electrode spacers and the shelf stops.

9. Scrub the chamber, electrode and feedthrough connection with deionized water and a Scotch-Brite type scrub pad used for Teflon coated pans. (Performed as needed and routinely every year (PM2)).

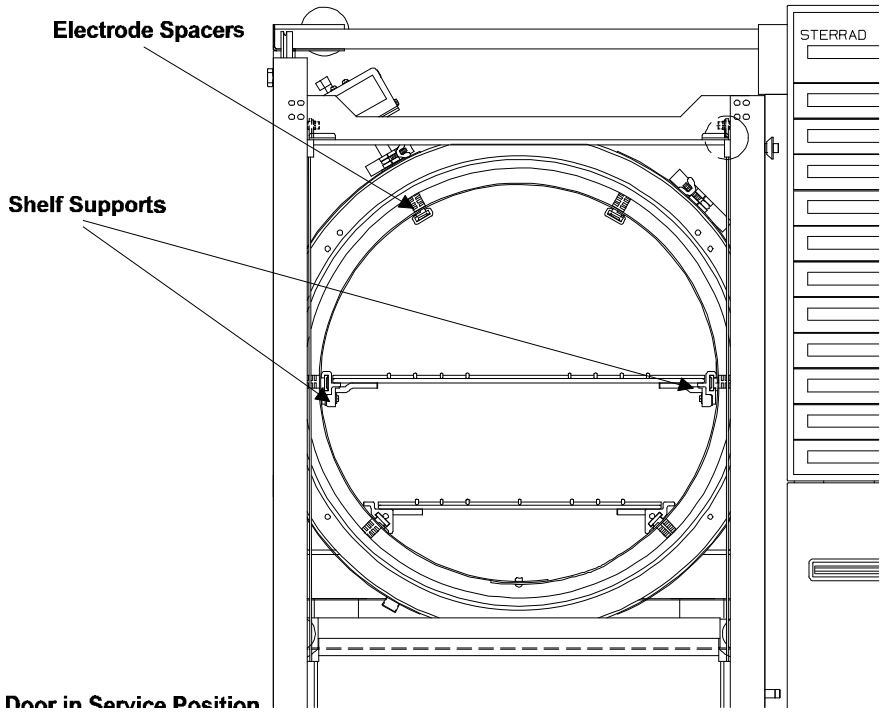


*Figure 7-6. Electrode Spacers/Shelf Support Locations*

# Replace the Electrode and Spacers

1. Place the electrode into the chamber. Starting with the ones on the bottom, insert 18 new electrode spacers and new shelf stops. Alternate the tabs up and down.

2. Insert the lower shelf supports into the chamber and slide them towards the back of the system. Replace the two sets of two screws (two each located at the front of each lower shelf support) fastening the lower shelf supports to the electrode assembly.

3. Insert the upper shelf supports into the chamber and slide them towards the back of the system. Replace the two sets of two screws (one located at the back and one located at the middle of each upper shelf support) fastening the upper shelf supports to the electrode assembly.

4. Slide the upper left and right joiners towards the back of the system.

5. Replace the Allen screw (located at the left, lower middle of the electrode) fastening the electrode to the chamber feedthrough.

6. Insert the upper and lower shelves into the chamber. (The diagram shows the shelves, shelf supports and spacers correctly installed.)

✔ ***Note:*** *Prior to tightening the screws on the front panels, verify the alignment of the cassette through the cassette door by inserting a cassette.*

7. Reinstall the front panel assembly and replace the screws fastening the front panel to the frame assembly. The screws are reached from the left and right side of the system at the rear of the front panel assembly. One set is located at the top of the panel, one set at the middle, and one set at the bottom of the panel. On Block 2 devices reattach the front panel and re-install the screws on the brackets.

8. Reconnect the cassette door assembly cable. Close the chamber door. Close the storage drawer.

### *Remove/Replace the Door Seal O-Ring*

1. Using a plastic tool at the wide hole in the O-ring groove, lift the O-ring from the groove. Discard the O-ring according to facility procedures.

2. Clean the groove thoroughly, using alcohol and a lint free cloth.

3. If the new O-ring is not lubricated, thoroughly, but lightly coat it with a vacuum grease recommended for high vacuum applications.

4. Starting at the top of the groove, press the O-ring into the groove at two or three inch intervals until it is held in place by the groove.

5. Then press it down completely into the groove making sure it is fully seated. Be careful not to stretch the O-ring as you work.

## Remove/Replace the Door

### *Open The Door For Servicing*

1. Open the storage drawer to reveal the right guard rail. Reach behind the open drawer and find the door stop lever.

2. Press **CLOSE DOOR**. When the door moves up, set the door stop lever down and press **OPEN DOOR**. The door opens to its service position, exposing the door O-ring that seals the chamber door, the rear surface of the door assembly and the chamber. See the diagram

### *Remove the Door*

This procedure is for removing a standard door and installing a standard door. Information on installing a “show” door is included in the replacement section.

✔ ***Note:*** *One step in this procedure requires the assistance of another person.*

1. Remove the system panels. Be sure to unplug the cassette door harness.

2. Release the air pressure using the mist separator relief valve. Remove the air lines from the cylinders.

3. Remove the door ground wire. Block 2 systems have a stop near the ground.

4. Disconnect the over-center sensor, over-center sensor flag, door heater, thermistor, and remove the door position sensor flag.

5. Manually place the door into the service position. so that the counterweight is at its highest point.

6. Prop the counterweight assembly so it doesn't drop (screwdrivers and Allen wrenches work well).

✔ ***Note:*** *The Block 2 counter weight is smaller.*

7. Remove the top door stop. Remove the Block 2 counterweight cable from the counterweight and from the top of the frame.

8. Remove the counterweight cable and tie-wrap it or tape it to the door.

9. Remove door cylinder cables from the bottom left and the bottom right. Note the differences in the video clips between Block 1.8 and Block 2 systems.

10. Unfasten the cables from the top of the frame. Tie wrap the cables or tape them to the door. DO NOT pull the cables out of their routing in the door.

11. Unfasten the second door cylinder cable and remove it from around the pulleys.

12. Verify that all cables are disconnected and secured so that they cannot be snagged. Verify that the door sensors, thermistor and door heaters are disconnected.

13. With a marker pen or pencil, mark the point where the left rail and chamber meet.

14. Remove the screws fastening the rail to the chamber.

15. Remove the screws holding the three cross bars and swing them to the right. (Block 2 has two cross bars that only need to be loosened on the left side).

16. Block 2 only. Remove the bracket holding the door alignment tool. Remove the hardware fastening the upper cross bar.

17. Loosen, but do not remove, the hex screw fastening the rail to the bottom of the frame.

18. Remove the screws fastening the rail to the chamber. Leave the middle screw in place, but loose.

19. This is the point where you need the second person to help you. Have the second person hold the door and simultaneously, move the left guide rail out and lift the door up and out. Be careful not to snag the wrapped cables. Set the removed door aside where it cannot be damaged. Move the guide rail back into place but do not tighten.

### Remove the Guide Rail

1. Remove the screw at the left side of the upper panel bracket, and rotate the bracket out of the way.

2. Loosen the left guide rail enough to install the door assembly.

3. Lower the door to the fixed stop and re-attach the left guide rail assembly and the upper panel bracket. Be sure that the glide buttons are still trapped in place over the fascia screw heads. More adjustments are made later in this procedure

## *Replace the Door*

1. Place 2 glide buttons over the two lowest screws retaining the fascia to the door. You may use a small amount of vacuum grease to hold the buttons in place until they are installed on the guide rails. Be sure to Remove the guide rails before proceeding.

2. Set the door in place and make sure the left guide rail and cross bars are in place and supporting it.

3. Make sure the end of the bar on Block 2 systems engages the opening on the left rail.

4. After the rails are securely fastened, place the door into the service position.

5. Using the alignment tools, align the rails so that the door tracks smoothly when operated. On Block 2 systems, used the attached alignment tool to align the rail to the frame.

6. Reconnect the ground.

7. If the chamber is out of alignment following door replacement, it should be aligned at this point.

8. Adjust and tension the door cables running between the door pulleys and guide rails so that the door hangs evenly and operates smoothly. The door should be able to easily move side-to-side while raising or lowering. It should not ride or rest on the side of one guide rail when the cables are correctly adjusted. The cables should only be tightened enough to allow the door to hang and operate smoothly, they should not be over tightened as this stretches the cables and stresses the brackets and pulleys.

9. Adjust the door cylinder cables. Tighten the cable to remove all slack but not to tension. There should be no play under the locknuts.

10. Manually raise the door and adjust the door stops so that the door over-center mechanism extends and evenly closes the door against the O-ring.

11. Route the cables over the pulleys. It is important that the cables fit into the correct tracks on the pulleys: the left track of the front pulley, and the right track of the rear pulley.

12. Adjust the door cables so that there is 15 - 20 mm clearance at the air cylinder hex nut when the door is in the locked position. Adjust the upper door stops to extend 21.5 mm.

13. Verify that there is a gap between the door and the rail. Install and reconnect the door over-center flag (the small flag packed loose with the door). Install the door sensor harness, thermistor, ground, heater harnesses.

14. After adjustments are made, increase the air pressure to 60-80 PSI and verify door closing speed and door operation. When the door speed and operation is satisfactory, lock the adjusting rings on the speed control valves. Lock all jam nuts to the cable ends.

15. Remove and replace the door seal o-ring.

16. Reinstall all panels.

17. If you are installing a show door, replace the front panel with the "show panel" included in the kit.

18. Perform a leak back test.

### *Replace the Door with a Show Door*

Use the same procedures to install the show door as use with a standard door. The only difference is in the handling of the harnesses and cables.

1. Install the door sensor harness only.

2. Tywrap the thermistor, ground and heater harnesses so that they don't interfere with the movement of the door. They are not used on a show door.

# Chamber Heaters Removal/Replacement

### *Remove the Heaters*

**HAZARDOUS CHEMICALS!· The primer and adhesive used in this procedure are caustic and have hazardous vapors. Be sure you are using them in a well ventilated room and that you protect your clothes and skin. You MUST wear side shield safety glasses, rubber gloves and a protective smock when using RTV adhesives and primers**

Following are the steps for removing a defective heater, cleaning the chamber of adhesive residue and installing a new heater. In addition, here is a list of additional supplies you will need to remove and install the chamber heaters.

Block 2 devices use self adhesive heaters. If you are replacing heaters on a Block 2 device, skip to the Block 2 Heater Removal/Replacement procedures

### Additional Tools Needed

- A scraper (do not use a razor blade)
- 200 grit sandpaper
- 3M Citrus Base Natural Cleaner
- Tape measure with millimeter increments
- Side shield safety glasses
- Rubber Gloves
- Protective Smock
- Duct tape
- Masking tape

1. Remove the insulation jacket from chamber. Remove the vacuum connections, the RF match, the injector pump and the Baratron.
2. Pull up the heater up to be replaced and remove it from the unit.
3. Remove the old adhesive from the chamber using the scraper, a razor blade or 3M Citrus cleaner, followed by isopropyl alcohol.
4. If needed, smooth the chamber surface using 200 grit sandpaper. All of the adhesive must be removed so you may use the scraper, sandpaper and cleaners in whatever order produces the best result.

Block 2 devices use self-adhesive heaters and there is much less residue left at removal. Do not rub out the manufacturing markings for the heaters.

## *Replace the Chamber Heaters*

1. Measure for both the top and bottom heaters in this step. (If you are only replacing the chamber head heater, go to step 4.) Measure 760 mm from the face of the chamber to the rear and make a mark. This is the location of the back edge of both the top and bottom heaters.
2. Now stand at the rear of the chamber and place the millimeter measuring tape against the stiffener rib. For the top heater measure from the stiffener rib clockwise around the chamber and make a mark at: 50 mm, and 126 mm on the circumference of the chamber. See the diagram
3. For the bottom heater measure from the stiffener rib CLOCKWISE around the chamber and make a mark at 875 mm and one at 951 mm on the circumference of the chamber. See the diagram

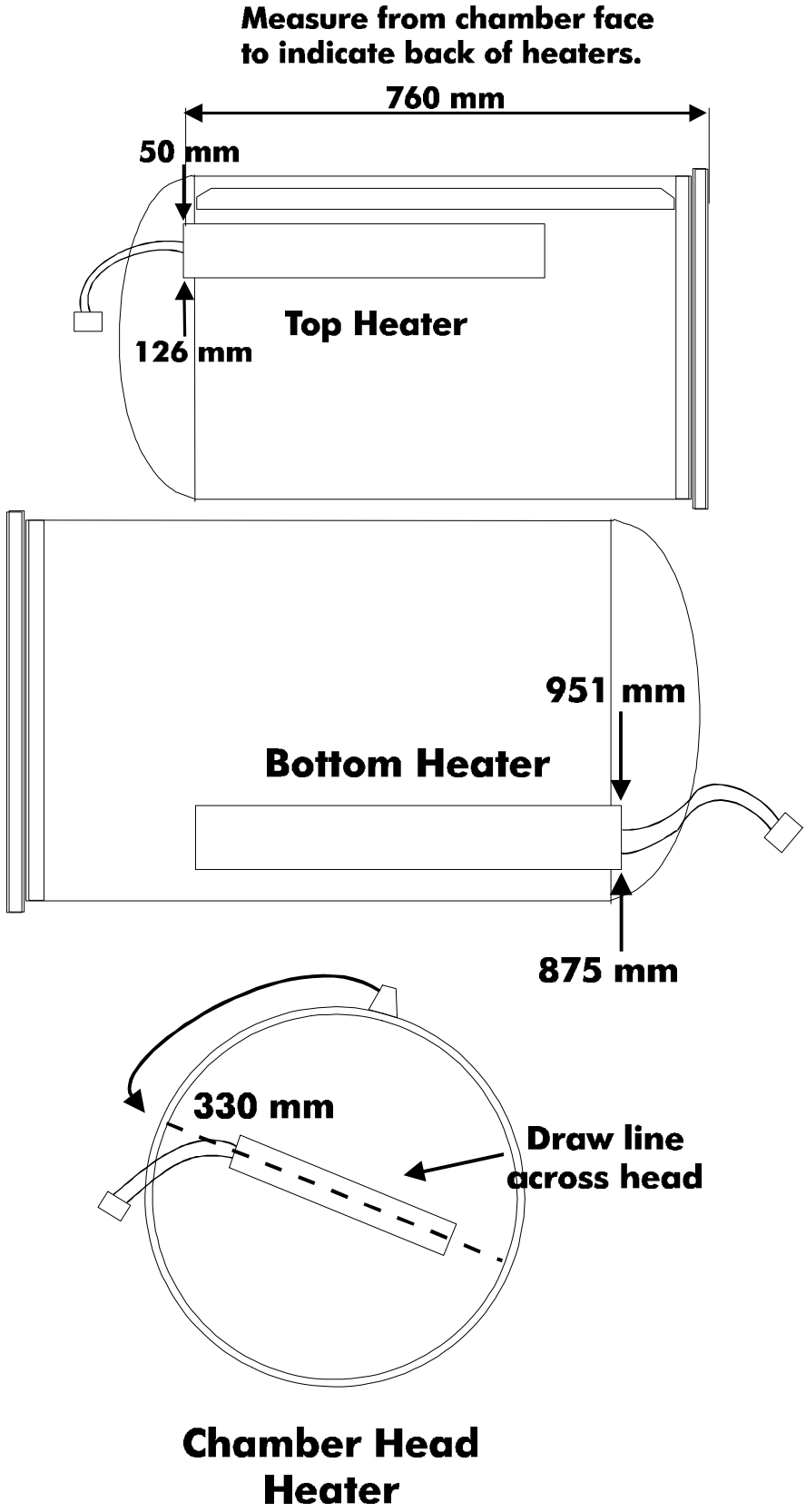


*Figure 7-7. Heater Measurements*

4. Mark the location of the chamber head heater by measuring from the stiffener rib COUNTERCLOCKWISE around the chamber. See the diagram. Mark the chamber head at 330 mm. Draw a line from that mark across the center line of the head. The heater straddles this line. It is centered about the chamber head with the heater wires at the optical port end.

5. Clean all mating surfaces of the heater and chamber with 3M Citrus Base Natural Cleaner followed by cleaning with isopropyl alcohol.

6. Using masking tape, mark off the areas where the heaters are to be installed.

### Using the Primer and Preparing the Adhesive

1. Do NOT use the primer or adhesive if they have expired dates.

2. Verify the expiration date of the primer.

3. Be sure you have measured and marked the chamber for the location of the heaters to be replaced. Brush a thin, uniform film of Silicone Primer onto the areas where the heaters are to be bonded.

4. Allow 1 hour (minimum) drying time.

   ✔ ***Note:*** *Do NOT handle or contaminate the coated surfaces. You may cover and leave overnight.*

5. Verify the expiration date of the adhesive.

6. Using the ratios shown below, mix at least 5 times the volume of adhesive needed to allow for expansion during de-aeration.

| | |
|---|---|
| Mix ratio | RTV = 99.5% (40 grams)<br>DBT Catalyst = 0.5% (10 drops) |
| Pot Life: | 1 hour (time may be extended by freezing) |
| Cure time: | 24 hours at 25º C or 8 hours at 40º C. |

   ✔ ***Note:*** *Do NOT mix more than can be used with the 1 hour pot life.*

7. Thoroughly mix the adhesive and catalyst together. Place the adhesive mixture in the chamber.

8. Run the vacuum RF test to de-aerate the mixture for at least 10 minutes.

9. Verify the correct heater voltage from the markings on the heater (120V for -001 or 240V for -002)

10. Clean the unprinted side of the heater with 3M Citrus Base Natural Cleaner and then isopropyl alcohol.

11. Spread a thick (approximate 1/32" - 1/16"), uniform coat of adhesive mixture, without entrapped air, onto the marked areas of the chamber.

12. Press the unprinted side of the heaters to the adhesive coated areas created in the previous step.

    ✔ ***Note****: The leads at the rear of the chamber are for the side heaters and the near port is for the rear heater.*

13. Using a weight, apply pressure against the heaters to make sure they are firmly attached. Do not remove adhesive that is squeezed out from the heater unless it is an excessive amount. No voids should be visible and a fillet is preferred.

14. Strap the heater with duct tape for 24 hours until the adhesive cures. DO NOT apply power to the heaters until they have cured.

    ✔ ***Note:*** *DO NOT DISCARD remaining adhesive. Allow the adhesive to cure in the container and then dispose of according to hospital procedures.*

15. After the heaters have completely cured, plug in the heater power and perform a heater test and verify heater temperature as shown in the Product Certification section.

## *Heater Removal/Replacement (Block 2)*

1. Remove the "wet suit" cover from the chamber. Disconnect the heater to be replaced.

2. Pull the heater off the chamber.

3. Clean any adhesive residue from the chamber surface using 3M Citrus cleaner. Do not rub off the manufacturing marks for heater replacement.

4. Peel off the adhesive backing from the new heater.

5. Press the heater firmly onto the location indicated by the manufacturing marks.

6. Smooth the heaters so they are completely attached to the chamber surface.

7. Plug in the heater power supplies and perform a heater test to verify heater temperatures as shown in the product certification section.

# Remove/Replace the Feedthrough

Replacement of the feedthrough requires the use of the Feedthrough Kit listed in Tools and Test Equipment Some additional supplies are needed as listed below:·

- Side shield safety glasses
- Rubber gloves
- Protective Smock
- Duct tape
- Scale that measures grams.
- Cork or cap that fits tightly in or on the feedthrough opening.

## *Remove the Feedthrough*

1. Shut down the system and allow it to cool completely before proceeding.
2. Remove the screws fastening the RF match to the chamber.
3. Remove the RF cable.
4. Remove the shelves and electrode from the chamber.
5. Cover the inside machinery so that the debris from drilling and/or removing the epoxy does not sift into the vacuum pump.
6. Using Visegrip pliers, grasp the feedthrough from outside the chamber. Turn the feedthrough forcefully to break the bond. You may need to hit the feedthrough with a hammer from inside the chamber until it falls out.

   ✔ ***Note****: If the feedthrough does not come out, you may need to drill it out. Be sure not to drill through the chamber.*

7. On Block 2 systems, using Visegrip pliers, break off the feedthrough from the outside and inside.

   ✔ ***Note:*** *The entire epoxy "plug" must be hammered or drilled out of the feedthrough port. Be sure you do not damage the chamber.*

8. Block 2 only. CAREFULLY use a punch to remove epoxy from the air holes in the feedthrough port lip. Make sure these holes are completely free of epoxy as these holes release trapped air when the new epoxy is applied.

## Replace the Feedthrough

Review important points prior to any replacement procedures.

1. Thoroughly clean the replacement feedthrough and the inside of the feedthrough port with deionized water and a Scotch-Brite type scrub pad used for Teflon-coated pans.

**HAZARDOUS CHEMICALS!· The primer and adhesive used in this procedure are caustic and have hazardous vapors. Be sure you are using them in a well ventilated room and that you protect your clothes and skin. You MUST wear side shield safety glasses, rubber gloves and a protective smock when using RTV adhesives and primers**

2. Using the containers and epoxy in the feedthrough kit, mix in the proportions shown below. Use a gram scale for precise measurement. Gram scales can usually be obtained at the customer site.

✔ ***Note:*** *Do not mix more than can be used during the 40 minute pot life.*

| | |
|---|---|
| Mix ratio | 4 grams resin (Part A) to 1 gram activator (Part B) |
| Pot Life: | 40 minutes. |
| Cure time: | 24 hours at 25º C or 8 hours at 40º C. |

3. Cover the feedthrough port so that you can pull a vacuum in the chamber.

4. Mix the resin and activator thoroughly and de-aerate in the chamber (using the Vacuum/RF test) for approximately 10 minutes until all frothing ceases. Be sure to place the epoxy containers in the chamber so they won't tip over (use a tray and wrapping material).

✔ ***Note:*** *Do NOT use lubricant when installing O-rings.*

5. Fit 2 O-rings onto the feedthrough. See the diagram.

6. Block 2 only. Install one O-ring as shown in the Block 2 feedthrough diagram. Screw the epoxy tool, without the prominent edge, onto the end of the feedthrough.

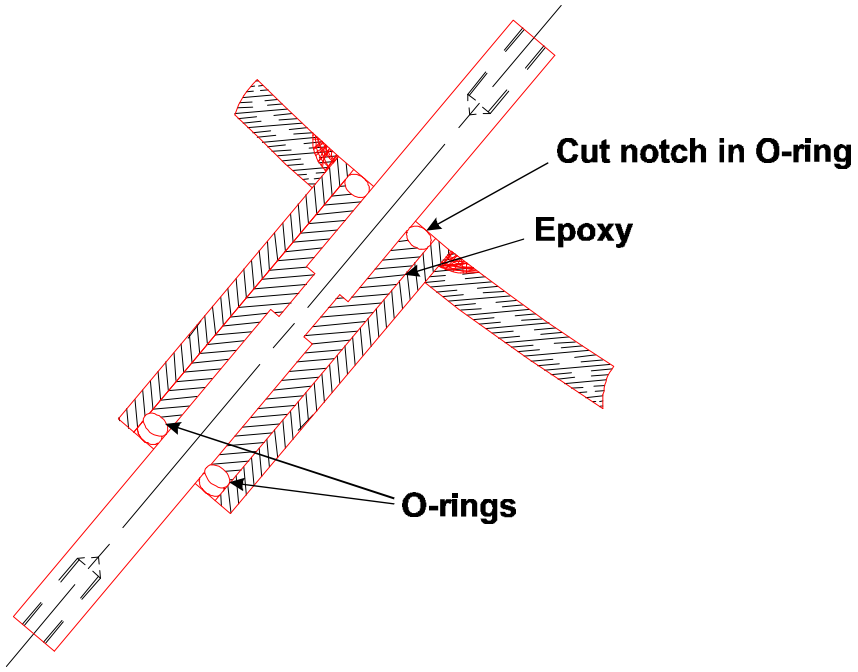


*Figure 7-8. Feedthrough Diagram*

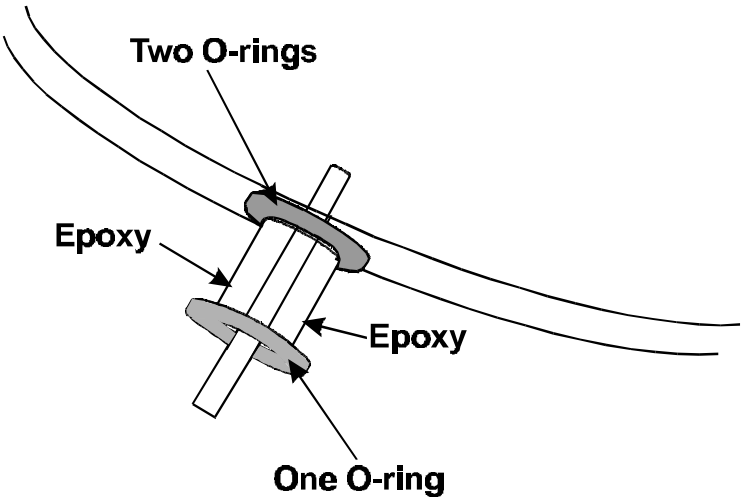


*Figure 7-9. Block 2 Feedthrough*

7. On Block 2 systems, wrap the outside of the feedthrough port with tape to block off the air holes.

8. From the outside the chamber, install the feedthrough until the tool touches the chamber feedthrough port. The O-rings hold it in place.

9. Mask the area around the feedthrough port inside the chamber to prevent the epoxy from spilling on the chamber.

10. Carefully and slowly pour the adhesive into the feedthrough opening. Be careful not to trap air while pouring. Use a metal probe to break any trapped air pockets.

11. Fill the cavity to within 1/8 inch of the top. (On Block 2 fill until the epoxy enters the O-ring groove.) Clean any excess epoxy from the chamber with deionized water and a scrub pad.

12. Cut a 1/16 inch section out of the remaining O-ring.

13. Block 2 only. (Do not cut any O-rings as in the step above). Place two O-rings onto the feedthrough from inside the chamber as per the Block 2 feedthrough diagram. Push the O-ring(s) well down into the epoxy. Wipe off the excess epoxy from the feedthrough and the top O-ring.

14. Attach the epoxy tool with the prominent edge to the end of the feedthrough. Leave the tool in place until the epoxy has cured. DO NOT allow any epoxy to adhere to the tool.

15. Place the remainder of the mixed epoxy into a tray in the chamber. Allow the epoxy to cure undisturbed, with the chamber heaters on, for 8 hours. The cured epoxy in the container offers a quality assurance sample.

16. Open the chamber door and inspect the sample for air bubbles. Remove the epoxy tool from the feedthrough. Use an Ohmmeter to verify that no electrical shorts exist between the chamber and the feedthrough.

17. Perform a leak back test.

✔ ***Note:*** *Use new screws and washers provided in kit to install each end of the RF feedthrough.*

18. Reinstall the electrode, electrode spacers, shelf stops and shelves according to the electrode installation procedure presented previously.

19. Reinstall the RF match. Perform the RF power test and a second leak back test as shown in the Product Certification section.

20. Run a complete empty chamber cycle.

# Remove the Sight Glass

The sight glass should only be removed if it is suspected of being cracked and causing leaks.

✔ ***Note:*** *Wear gloves for this procedure as there may be broken glass present.*

1. Remove the 8 screws holding the bezel. See the diagram
2. Remove the window carefully.
3. Wipe off the O-ring with a damp cloth to remove any small pieces of glass if you are not going to replace it with a new one.

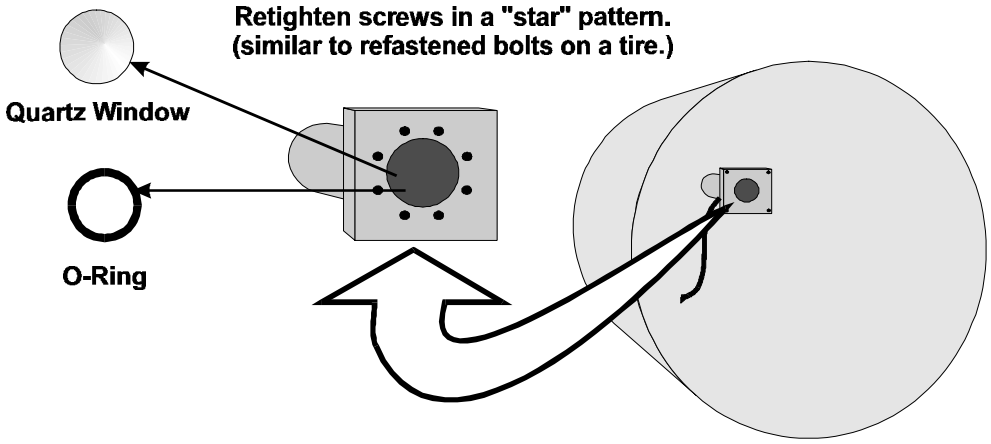


***Figure 7-10. Sight Glass Replacement***

# Replace the Sight Glass

1. Install the clean O-ring or, preferably, a new O-ring.
2. Place the quartz window against the O-ring between the bezel and plate. Loosely attach the screws.
3. Tighten the screws in a “star” pattern (similar to the method used to tighten bolts on a tire.)

# Chapter 8

# Pneumatic Subsystem

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# Introduction

This chapter details the pneumatic subsystem. Included in this chapter are the theory of operation as it relates to the pneumatics, the tools needed for maintenance, calibration of the pneumatic pressure switch, removal and replacement of the AC and control enclosures and a list of field replaceable parts.

## Different Pneumatic Configurations

The STERRAD® 100 system is currently in the **Block 2.0** and STERRAD **100 S** System phase. These versions of the STERRAD 100 Sterilizer is slightly different, in appearance only, from the Block 1.8 STERRAD 100 system. The calibration differences are noted in the text.

STERRAD **100 S** Systems have a dual position door solenoid that prevents the door form opening during a power interruption in the vent stage.

When you see the STERRAD Icon next to the text, as with this paragraph, that is the symbol for a configuration other than Block 1.8.

## Pneumatic Subsystem Description

The pneumatic subsystem is comprised of the air compressor, powered through a pressure switch, an air storage tank, and a pneumatic panel. The compressor is controlled, through the pressure control switch, to turn on the compressor at 5.1 Bar (60 psig) and off at 6.5 Bar (80 psig) (414 and 552 kpa), and to dump the compressor head pressure whenever the pump is not running, or the power to the compressor fails.

# Pneumatic Theory of Operation

The pneumatic subsystem provides a source of pressurized air used to open and close the process chamber door, operate the injector pump clamp, and pressurize the top of the cell, forcing hydrogen peroxide from the cell into the injector valve.

The pneumatic subsystem is comprised of the air compressor, powered through a pressure switch, an air storage tank, and pneumatic panel. The compressor is controlled, through the pressure control switch, to turn on the compressor at 5.1 Bar (60 psig) and off at 6.5 Bar (80 psig) (414 and 552 Kpa), and to dump the compressor head pressure when ever the pump is not running, or the power to the compressor fails.

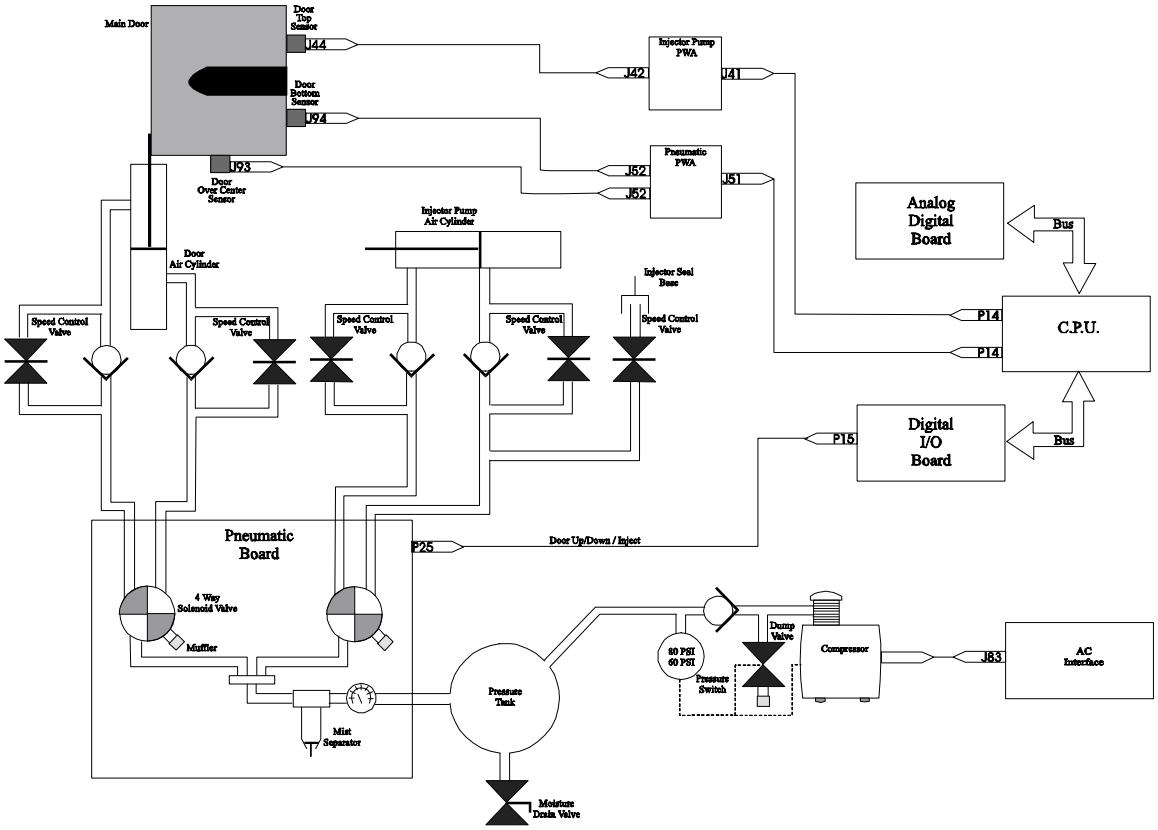


***Figure 8-1. Pneumatic Subsystem***

# Pneumatics Calibration

**IMPORTANT!:** Your first step when servicing a system is to verify that the system is **properly connected to the power source**, and to make sure all the **subsystems are properly connected to the AC** system and all circuit breakers are on and functioning normally. Once you have verified these things, proceed with your calibration steps.

## Pneumatics Pressure Switch

✔ ***Note:*** *You do not need to remove the front panel to calibrate the pneumatic switch on a* ***Block 2*** *device.*

1. Remove the cover from the pneumatic pressure switch, and note the instructions diagram located inside the cover.

✔ **Note:** *The pneumatic switch is located on the right side of the system in* ***Block 2*** *devices. In both systems the switch is mounted upside- down relative to the instructions diagram and the adjustment screws are located on the lower portion of the assembly. As viewed from the front, the right screw adjusts both the cut-in and cut-out pressures together. The left screw adjusts the cut-out pressure only, without affecting the cut-in pressure. See the pneumatic switch diagram.*

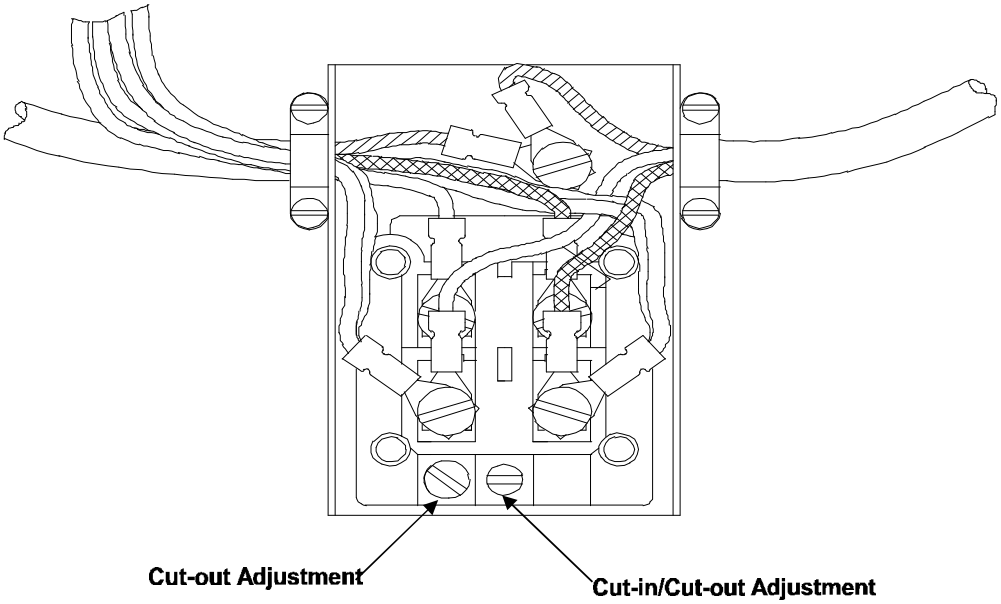


***Figure 8-2. Pneumatic Switch***

2. Adjust the *right* screw until the pneumatics pump begins operation at 60 ±3 PSI, as indicated by the air pressure gauge located on the pneumatics panel (clockwise rotation increases the pressure set point).

3. Adjust the *left* screw until the pneumatics pump stops operation at 80 ±3 PSI, as indicated by the air pressure gage located on the pneumatics panel (clockwise rotation increases the pressure set point).

# Pneumatics Removal/Replacement Procedures

The pneumatic panel devices are removed by unfastening the screws retaining them to the panel. The jumper on the pneumatic board should be configured as shown in the diagram above. Note the differences between Block 1.8 and **Block 2**.

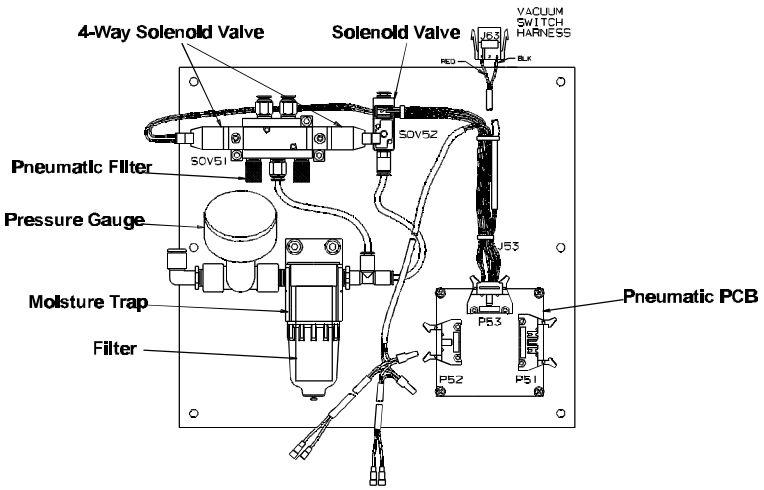


***Figure 8-3. Pneumatics Panel***

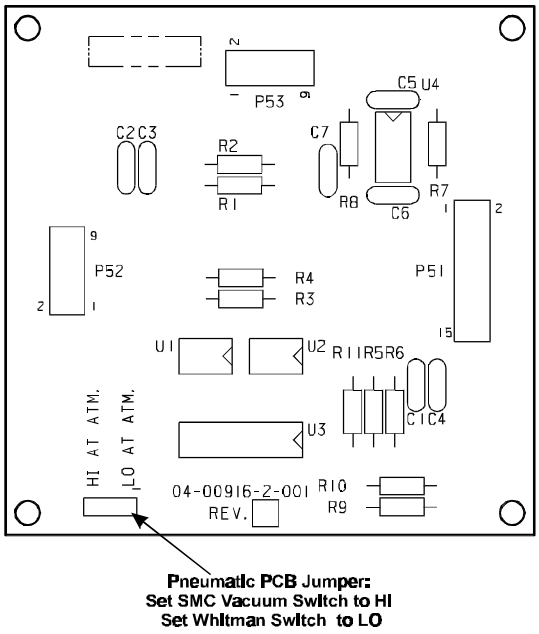


***Figure 8-4. Pneumatic Board***

# Chapter 9

# AC Subsystem

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# Introduction

This chapter details the AC interface. Included in this chapter are the theory of operation as it relates to the AC subsystem; the tools needed for maintenance; calibration of the subsystem; removal and replacement of the AC enclosure and a list of field replaceable parts.

## Different AC Configurations

The STERRAD® 100 system is currently in the **Block 2.0** and **STERRAD 100 S System** phases. (**100 S** denotes a short cycle configuration.) The **Block 2.0** version of the STERRAD 100 Sterilizer is slightly different, with regards to the AC interface, from previous versions of the STERRAD 100 System. These differences are mostly in appearance. Calibration and removal/replacement differences are noted in the text.

When you see the STERRAD Icon next to the text, as with this paragraph, that is the symbol for a configuration other than Block 1.8.

# AC Subsystem Theory of Operation

The AC subsystem provides power to the entire sterilizer. The power is controlled by a series of amplifiers, transformers and switches. Power can be applied to the system using the safety interlock switch. Removal and replacement procedures are included for the AC enclosure. however, no calibration procedures or product certification is needed that directly affects the AC subsystem.

# AC Calibration

The AC subsystem does not require calibration. However, you should verify that the system is **properly connected to the power source**, and to make sure all the **subsystems are properly connected to the AC system** and all circuit breakers are on and functioning normally. Once you have verified these things, proceed with your product servicing.

# AC Removal/Replacement

The removal and replacement procedures below show how to remove the AC enclosure. The relays, transformers, and circuit breakers are field replaceable units. They are held in place by screws and some are plug in parts. Because the removal of these components is self-evident, they are not detailed here.

The following diagrams can be used with all AC replacement procedures.

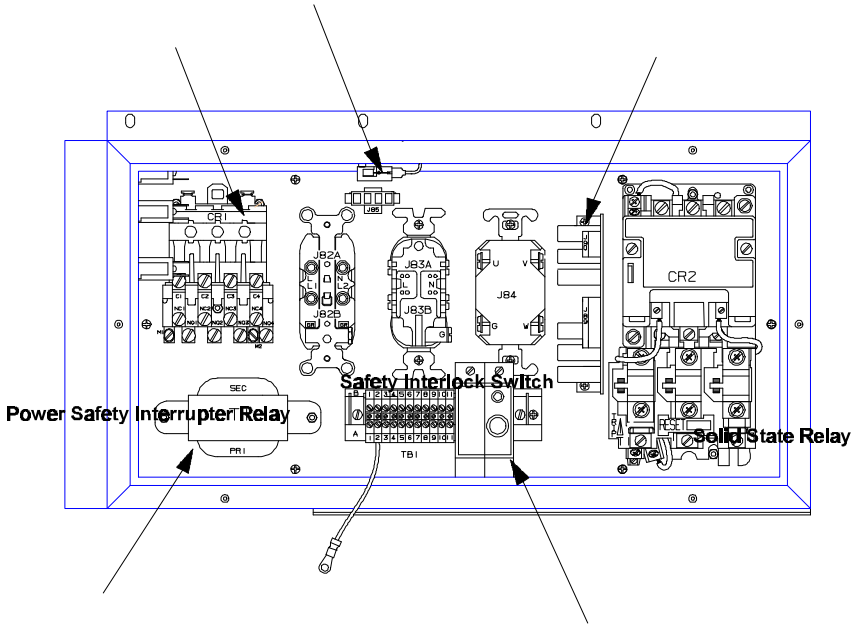


***Figure 9-1. AC Enclosure Block 1***

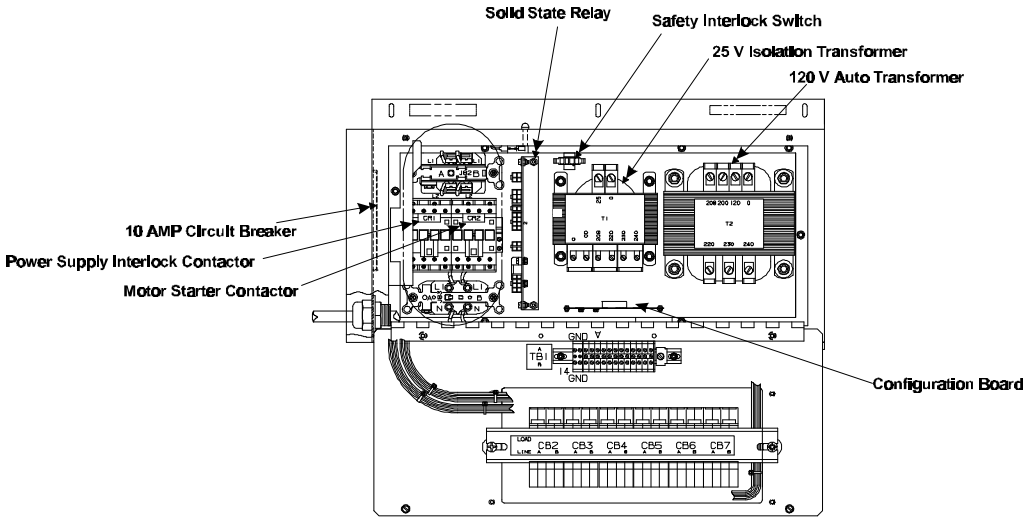


*Figure 9-2. AC Enclosure Block 2*

# Remove the AC Enclosure

1. Remove the system panels. Unplug all subsystems: vacuum pump, compressor.
2. (Block 2) Disconnect the vacuum pump harness and grounding strap.
3. Unscrew the unit from the frame. All the screws are on one side of the unit.
4. Remove the front panel and set it aside. It must be attached to the new enclosure.
5. (Block 2) Remove the thermal overload relay and the configuration board from the old enclosure and set them aside. Be sure to place the configuration board in a static safe area.

# Replace the AC Enclosure

1. (**Block 2**). Snap the configuration board from the old enclosure into the new enclosure. Attach the thermal overload relay. The wiring order is as follows: 28 to T1, 29 to T2, 30 to T3, 80 to 96, and 90 to 95.
2. Remove the front panel from the new enclosure and attach the retained panel from the old enclosure.
3. Attach the AC enclosure to the frame (6 screws).

4. (**Block 2**). Connect the vacuum pump harness and ground.
5. Plug in the subsystem as labeled on the enclosure.

# Remove the Solid State Relay Board

1. Turn off the main circuit breaker.
2. Open the AC enclosure panel.
3. From outside the enclosure, disconnect all electrical harnesses from the solid state relay board

4. Remove the two screws fastening the solid state relay board to the enclosure. On Block 2 systems the screws are located on the outside of the enclosure.
5. From inside the enclosure, disconnect the harnesses attached to the solid state relay board.
6. Remove the solid state relay board.

# Replace the Solid State Relay Board

1. Replace the solid state relay board
2. From inside the enclosure, reconnect the harnesses attached to the solid state relay board.

3. Replace the two screws fastening the solid state relay board to the enclosure. On **Block 2** systems the screws are located on the outside of the enclosure.
4. From outside the enclosure, reconnect all electrical harnesses to the solid state relay board.
5. Close the AC enclosure panel.
6. Turn the main circuit breaker ON.

# Chapter 10

# Radio Frequency (RF) Subsystem

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# Introduction

This chapter details the radio frequency (RF) subsystem. The sections in this chapter briefly describe the functions of the RF subsystem and the product certification. The RF subsystem has no specific calibration procedures, nor does it have a complicated removal procedure.

# Different RF Configurations

The STERRAD® 100 system is currently in the **Block 2** and STERRAD **100 S** System phase. These versions of the STERRAD 100 Sterilizer is slightly different, in appearance only, from the Block 1.8 STERRAD 100 System. The calibration differences are noted in the text.

When you see the STERRAD icon next to the text, as with the paragraph above, that is the symbol for a configuration other than Block 1.8.

# RF Theory of Operation

The radio frequency (RF) subsystem comprises the upper enclosure at the rear, right side of the STERRAD 100 Sterilizer (called the RF generator), the RF match module that connects it to the process chamber, and the RF power cable that joins the two. The generator contains an amplifier and a switching power supply.

The RF generator, turned on and off by signals from the control subsystem, generates a frequency of 13.56 MHz at a power of 400 Watts nominal, 365 W minimum. This power is leveled using a closed loop feed back circuit that detects and compensates for variations in load impedance. The amplifier receives input power from an adjustable 750 W AC/DC, switch-mode power supply. The amplifier efficiency is greater than 75% into a 50 ohm load. The RF-amplifier features an automatic self-protection circuit for high VSWR conditions, a thermal overload trip and buffered outputs representing delivered and reflected power.

The RF power system interfaces with the STERRAD 100 Sterilizer through two connectors. These are an AC input plug and a 15 pin subminiature D control connector. The output of the RF Enclosure and the input to the matching network both use a BNC female bulkhead connector. The output of the matching network is connected to the STERRAD 100 Sterilizer chamber via a copper rod, drilled and tapped for an M3 fastener. The RF Match is grounded to the chamber by trapping it between nuts on a 3/8” NPT conduit welded to the chamber.

The firmware is programmed to detect RF-system failures at three levels. Upon entering the plasma stage, the controller monitors the pressure in the chamber and controls the throttle valve to keep the pressure at 500 ±25 mTorr. The system waits until the pressure is at 525 mTorr. If the pressure in the chamber is not down to 525 mTorr in 3 minutes, from the start of plasma stage, the process aborts, and prompts the user that there is insufficient vacuum for plasma. At 525 mTorr the controller turns on the RF power supply and after 700 milliseconds turns on the RF amplifier to light plasma. The RF delivery power is monitored by the controller, and the cycle is canceled according to the following criteria:

- If delivery power is under 100 watts.
- If delivery power is between 100 and 200 watts.
- If delivery power is not at least 365 watts, but is greater than 200 watts, after 15 seconds, the system turns off the RF-amplifier and power supply then turns it back on (RESET) to try again. The system keeps trying at 15 second intervals for 2 minutes and then stops.

If any of the above situations occur, appropriate error messages are generated. See the System Messages section or look up RF using Find+ to view the RF related error messages.

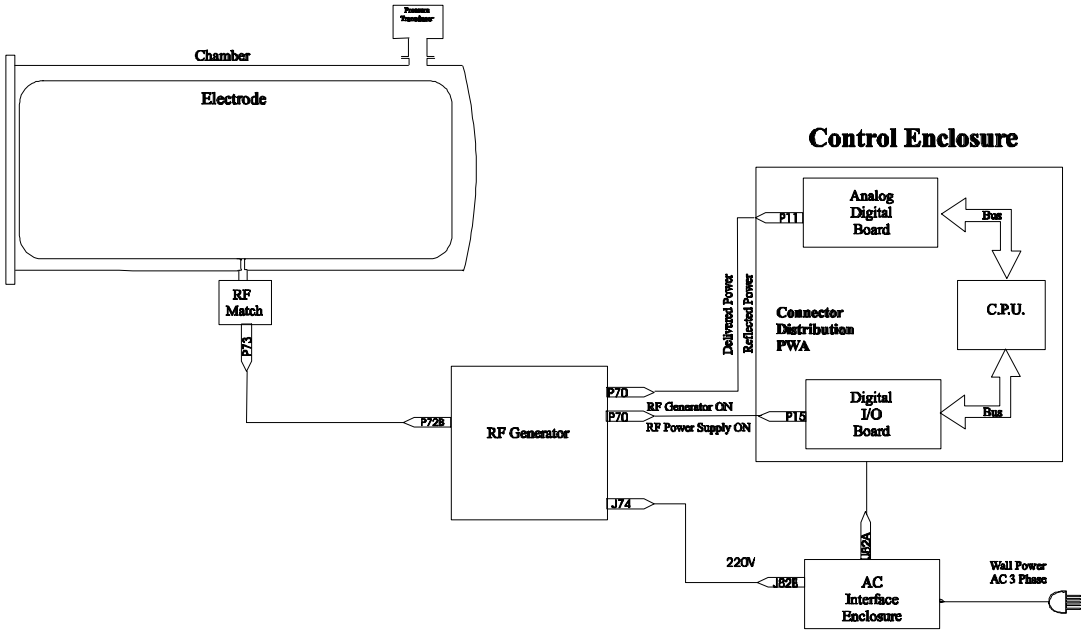


***Figure 10-1. RF Subsystem***

# RF Calibration

**IMPORTANT!:** Your first step when troubleshooting a system is to verify that the system is **properly connected to the power source**, and to make sure all the **subsystems are properly connected to the AC** system and all circuit breakers are on and functioning normally. Once you have verified these things, proceed with your troubleshooting steps.

RF Calibration is performed during the AutoTest procedures. See the RF Test in the AutoTest Appendix.

# RF Removal/Replacement

The RF enclosure, the RF Match and the feedthrough are field replaceable unit. The RF generator is not replaceable. If the generator needs to be replaced, the whole enclosure must be replaced. The feedthrough replacement is found in Chapter 7.

## Remove the RF Enclosure

1. Unplug the RF generator from the controller.
2. Unplug the unit from the AC power.
3. Unscrew the RF enclosure from the frame and remove it from the system. See the enclosure diagram

To replace the RF enclosure do the following:

1. Attach the RF enclosure to the frame using the 6 screws. See the diagram.
2. Plug in the RF generator into the controller.
3. Plug in the AC power.

## Remove the RF Match

1. Remove the 5 screws securing the RF match cover. Remove the RF match cover.
2. Remove the nut and screw securing the RF match to the feedthrough. See the RF diagram.

To replace the RF match, do the following:

1. Attach the RF match to the feedthrough using the nut and screw.
2. Replace the RF match cover.

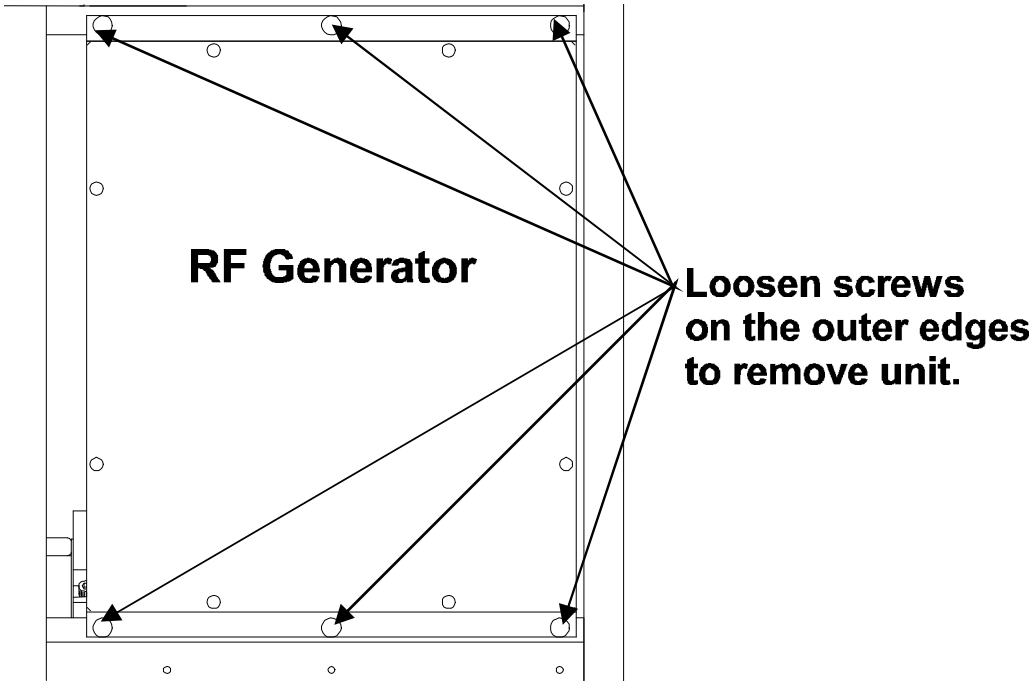


*Figure 10-2. RF Enclosure*

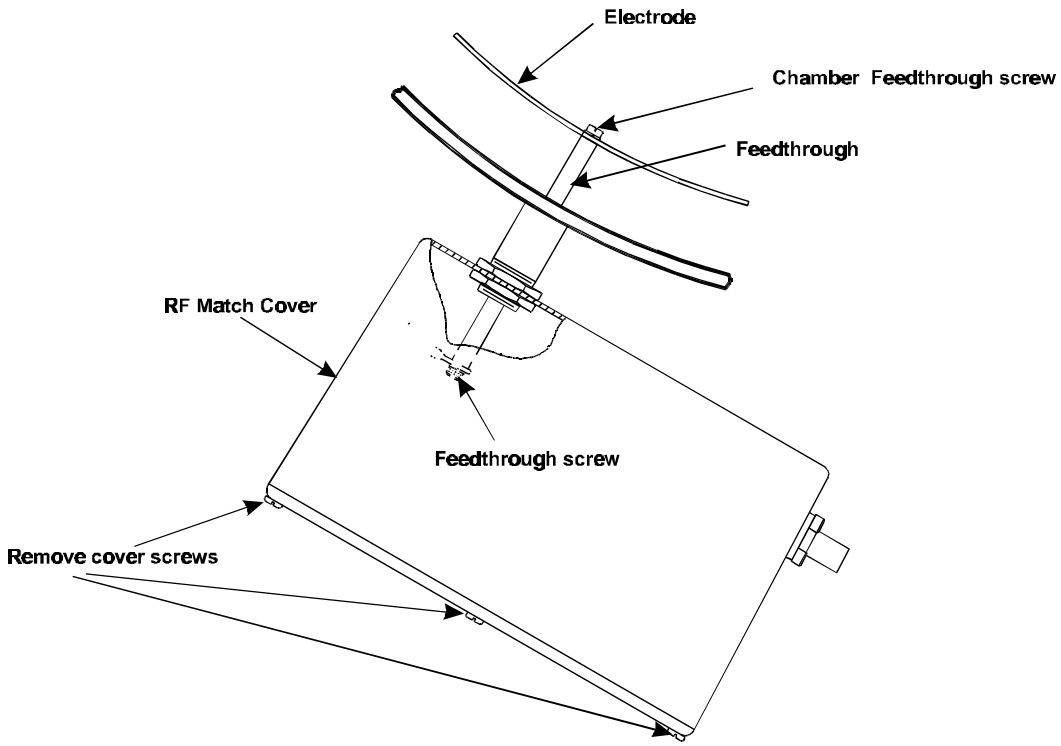


*Figure 10-3. RF match*

# Chapter 11

# System Installation

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# Introduction

This section describes how to uncrate, assemble, set up and initialize a new STERRAD® 100 Sterilization System. Following initialization, the system performance must be verified using the product certification procedures.

This installation procedure is for the **Block 2** systems as 1.8 systems are no longer available for new installation. If you have an unusual circumstance where you are installing a system version that precedes **Block 2**, please contact ASP Technical Services.

# Pre-Installation

Perform the following steps prior to uncrating the system. It is a good idea to have performed these steps prior to delivery of the system.

✔ ***Note:*** *If the seismic restraint is being installed, the hospital must have identified the location of the restraints and have pre-drilled the proper holes.*

1. Prior to your arrival, verify the number of cartons and items shipped to the customer.

2. Confirm that a proper location exists for correct installation; the location should be the correct size for the unit with the needed amount of clearance in front and on the cassette access side if necessary.

3. Verify that the AC power connection is in place, is the proper voltage and phase rotation and is activated. If the power requirements are not met, notify the hospital engineering department immediately so they can correct the problem. The phase rotation should be CBA, that it is, it should be counterclockwise from standard ABC phase rotation.

4. Make sure that the “route” from the delivery area to the installation area is large enough to accommodate the system and is not blocked by other equipment.

5. At the customer site, verify that the system and all necessary operating supplies have arrived.

# Uncrating the System

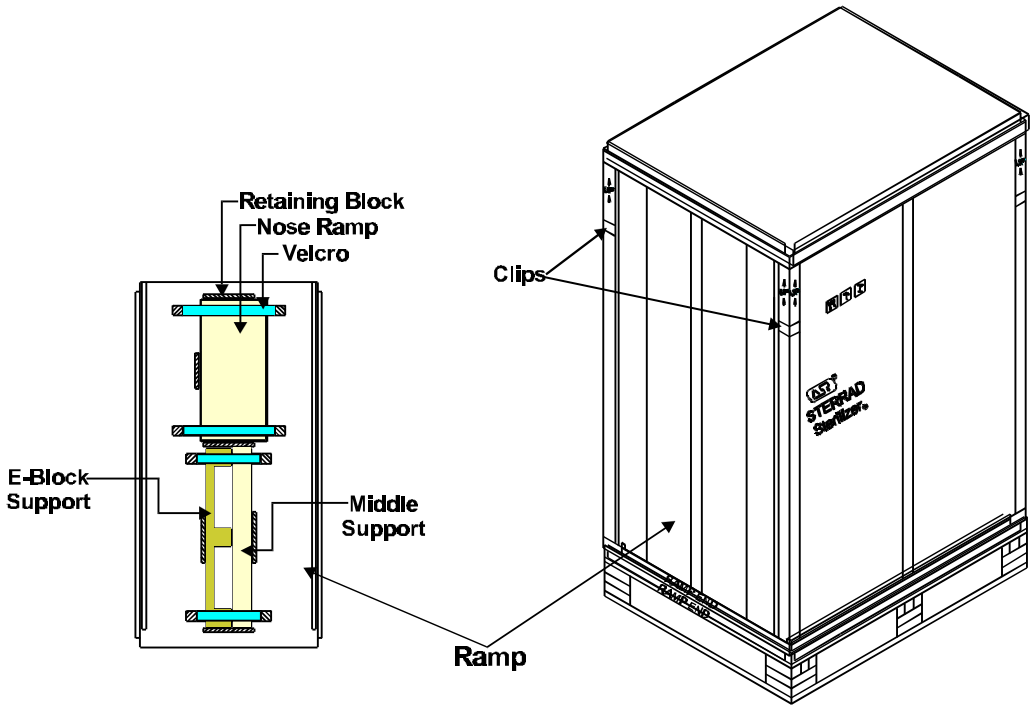



***Figure 11-1. Shipping Crate***

The Accessory Installation Kit consists of two boxes. One is on top of the unit, the other is inside the cassette chute. The side of the crate that forms the ramp is marked at the bottom of the crate. Be sure the ramp and ramp supports are securely positioned before moving the system.

1. Position the crate on a level surface so that the ramp side faces an open area large enough for the ramp to be extended and the unit removed..

2. Cut the banding and immediately dispose of it.

3. Using a screwdriver remove the two clips holding the ramp in place.

✔ *Note: The crate panels fit together with a tongue and groove mechanism. The top must be lifted off the sides and the sides must be lifted up from the pallet base.*

4. Slightly lift the top, then lift-up and lower the ramp.

5. Holding the Velcro straps, position the end of the ramp onto the crate and fasten the Velcro tabs. Unfasten the support blocks from the ramp.

6. Slide the nose ramp under the end of the main ramp.

   ✔ ***Note:*** *The middle support and the E-block support are angled to fit the angle of the ramp.*

7. Position the middle support under the center of the ramp and place the E-block support at the top of the ramp near the crate.

8. Remove the remaining clips, the top and the other three sides. Remove the foam protectors.

9. Remove the box on top of the unit.

10. Remove the system panels and, using a 14 mm (9/16") deep socket wrench, remove the hold-down bolts securing the machine to the pallet: to remove the front bolt slide the cassette storage drawer forward in order to reach the bolt. Remove the water drain bottle to reach the rear bolt. Remove the 4 x 4 block held in by the rear bolt.

11. Verify that the levelers in the front of the system are in the fully retracted (up) position.

12. Drape the electrical cord next to the vacuum pump to keep it out of the way.

⚠ **WARNING! USE A PARTNER. For safety purposes, this step requires the presence of at least two people capable of handling 100 lbs.**

13. With one person pushing carefully at the back of the system and one person guiding the system at the front, ease the system forward and guide it down the ramp until all four wheels are on the floor.

14. Verify that no air pressure is present in the pneumatics.

15. Remove the blanking flange from the bottom of the chamber. This removes any vacuum that may be present.

16. Remove the four 4mm hex bolts securing the door in the closed position.

17. Remove the two 6 mm hex bolts securing the counterweight.

    ✔ *Note: The screws are behind neoprene and fit through the chamber flange into the door.*

18. Manually open the door by pushing down on the top of the door. The door should open with ease. Remove the boxes from inside the system.

    ✔ *Note: The boxes shipped with the system contain vacuum system parts and other system accessories. Be sure to unpack the boxes completely before discarding.*

19. If you are going to move the unit to a different site, replace the side and lower back panels.

20. Once the unit is in position in the installation site, remove all exterior panels and temporarily store them in a safe location.

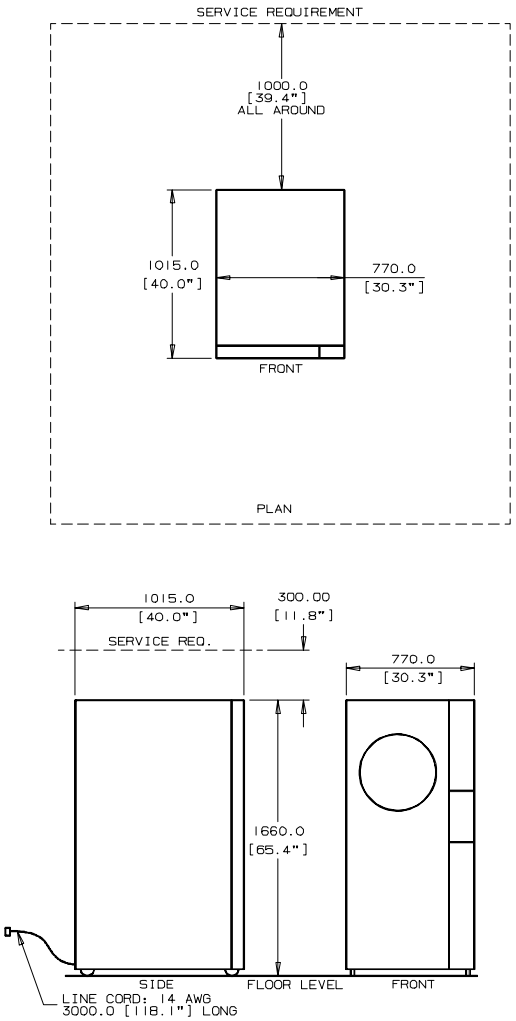



***Figure 11-2. Positioning Diagram***

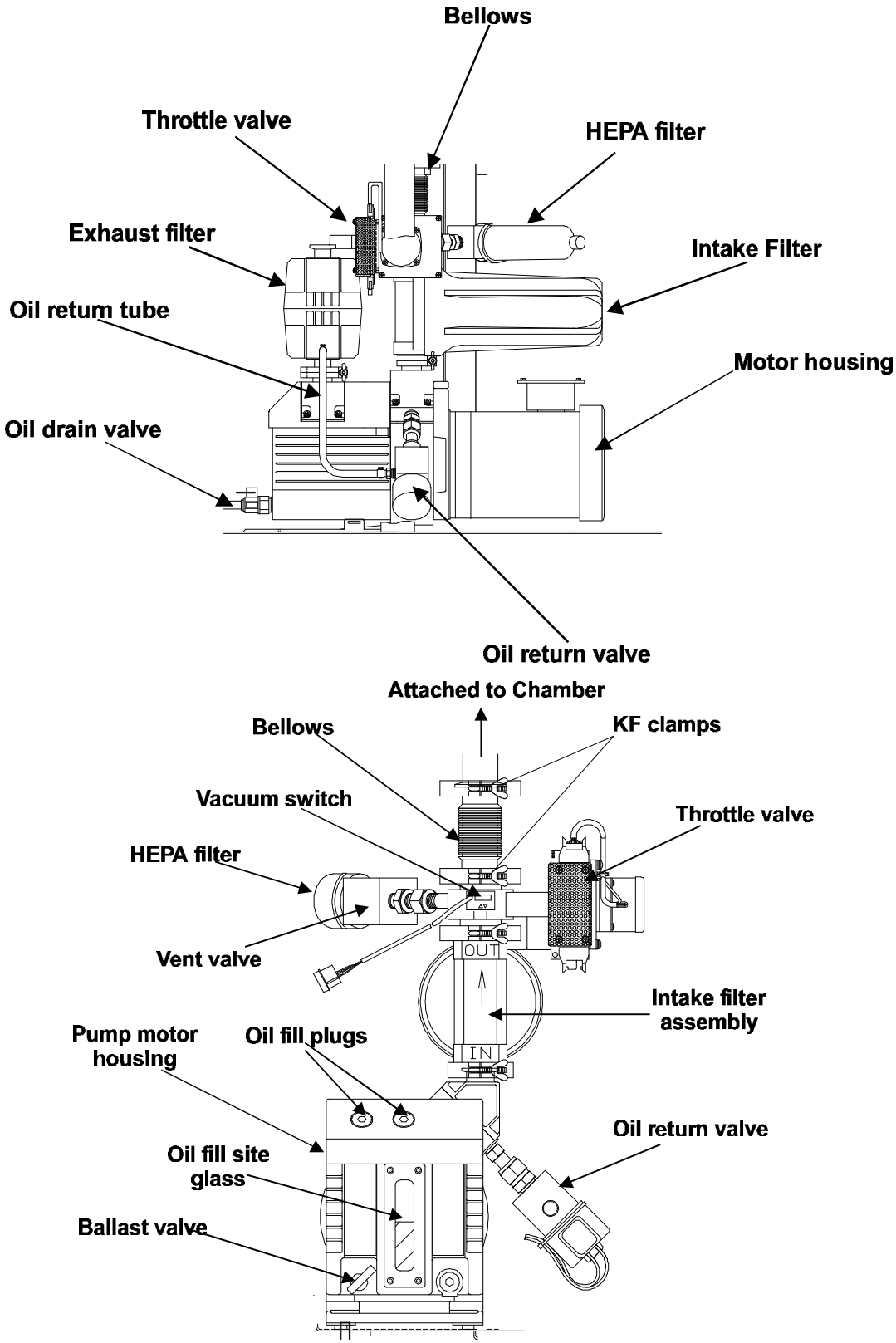



***Figure 11-3. Assembled Vacuum System***

Prior to assembling the unit make sure the following are completed or verified:

All vacuum fittings must be clean and free of foreign material.

*Lightly* coat all O-rings and seals with a *thin* film of high vacuum grease before installation.

KF clamps are supplied with wing nuts and should never e tightened more than finger tight. Do not use tools to tighten.

Change the oil in the vacuum pump.

⚠ **CAUTION: REMOVE the exhaust port blanking flange prior to operating the pump. Operating the vacuum pump with the exhaust port blanking flange installed can cause permanent internal damage to the pump.**

1. Remove the cable ties that fasten the pump intake filter assembly to the frame.
2. Remove the vacuum system parts from the boxes inside the system and the shipping crate.
3. Remove the flexible membrane and spacer from the pump inlet KF-25.
4. Remove the blanking flange from the vacuum pump exhaust port.
5. Attach the pump intake filter onto the vacuum pump inlet port and secure with a KF-25 centering ring and a KF-25 clamp. Verify that the flow arrow on the filter body points away from the pump and that the *IN port* connects to the pump.
6. Attach the throttle valve assembly to the pump intake filter. The pump side of the valve should be oriented toward the vacuum pump. Verify that the filter can be changed without a complete disassembly.
7. Attach the vent valve to the throttle valve assembly. Orient it with solenoid opposite pump side of the throttle valve and approximately parallel to the bellows. Secure the VCO fitting using a wrench. Apply a light coat of vacuum grease to the O-ring on the vent valve.
8. Attach the vacuum switch to the throttle valve. Using a wrench secure the VCO fitting. Apply a light coat of vacuum grease to O-ring on the vacuum switch.
9. Attach the bellows between the throttle valve and the chamber. Adjust the location of the pump intake filer and the throttle valve assembly as necessary. There should be minimum flexing of the bellows. Secure the bellows with 2 KF-40 centering rings and KF-40 clamps.
10. Attach the exhaust filter housing with a housing O-ring and tighten the KF-25 clamp to retain it. Orient it with the drain plug facing the side of the machine.
11. Remove the drain plugs and install the oil return fitting. Use the existing drain plug washer with the new fitting.
12. Attach the oil return line that connects the oil return solenoid and the exhaust filter.

13. Verify that the vacuum pump is filled with oil to the white indicator line.

14. Switch the gas ballast valve to OPEN.

15. Connect the throttle valve harness, vent valve, oil return solenoid and vacuum switch electrical connections. The illustration shown previously details the assembled vacuum system.

# Power Connection

1. Verify that the main circuit breaker located on the AC interface assembly is in the OFF position.

2. Plug the vacuum pump AC power connector into the designated receptacle on the AC enclosure.

3. Check all circuit breakers located on the AC enclosure. The circuit breakers are on the side of the unit and accessible with the panels in place. Verify that all circuit breakers are ON. Movement during shipping may cause the circuit breakers to trip.

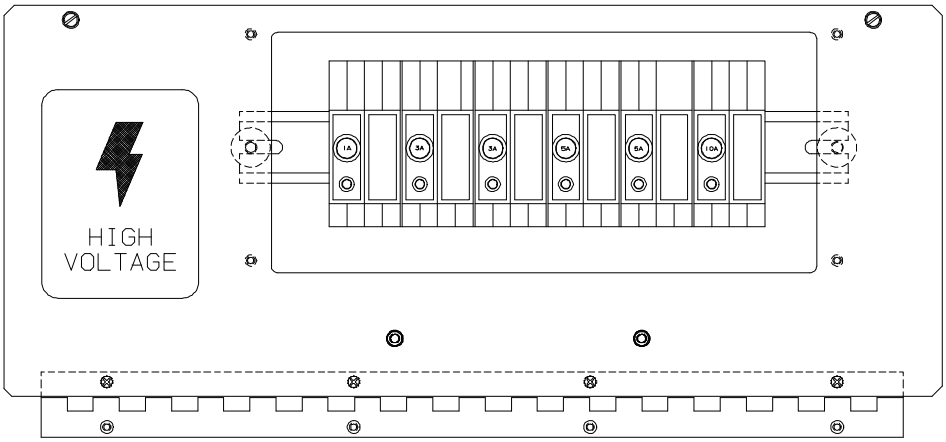



***Figure 11-4. Circuit Breakers***

4. Check that all of the connectors throughout the entire machine are in place and correctly mated. Some of the connectors may have worked loose in shipment.

5. Remove both control enclosure panels and ensure that all cables attached to the connector distribution PCBs are secure. Verify that the 3 PCBs are fully inserted into their sockets. Plug the system into the outlet.

# Installing the Seismic Restraints

This procedure is for both Block 1.8 and **Block 2** STERRAD 100 Sterilizers since the restraints can be used with either system type. This procedure is approved by the State of California Building Code as a valid seismic restraint procedure.

The Seismic Restraint installation kit contains:

two brackets

two subframe pieces (these are extension pieces used to build up the frame on Block 1.8 systems)

attachment hardware

drilling template

The kit should be ordered from Customer Service and the installation coordinated by ASP Technical Services.

## Pre-Installation Procedure-To Be Done by the Customer

The customer must identify the location for the STERRAD 100 Sterilizer and perform steps 1-4 below prior to any other installation procedures.

✔ ***Note:*** *There is a drilling template included in the kit. It has the proper dimensions and drilling positions.*

1. Position the rear bracket on the floor about 2 inches away from the wall (1-1/16 inches minimum) and mark the location of the holes for drilling. If there is an outlet in the wall at the desired installation location, add at least 3 inches to the distance.

2. Using the dimensions in the diagram below, and in the kit diagrams, measure carefully and position the front bracket on the floor (about 33 inches from the rear bracket). Mark the location of the holes for drilling.

3. Drill 12 each, 3/8 inch holes in the floor. (Use the manufacturer's recommendation for the anchor bolts if the size is different than 3/8 inch.)

   ✔ ***Note:*** *Use only approved anchor bolts shown in the table. (S=standard steel, SS=stainless steel).*

| Concrete Type | Min. fc (psi) | 3/8 " Anchor Type | ICBO Report # | Min Embedment (inches) | Test Loads |
|---|---|---|---|---|---|
| Hardrock | 2000 | Hilti Kwikbolt II (S) (SS) | 4627 | 1-5/8 | Direct Pull<br>Tension -1100 lbs<br>Torque 25 ft/lbs |
| | | Rawl Stud (S) (SS) | 4514 | 1-5/8 | |
| | | ITW/Ramset Trubolt (S) (SS) | 1372 | 1-1/2 | |
| | | Wej-It Anchor Bolt (S) | 1821 | 1-1/2 | |
| Lightweight | 3000 | Hilti Kwik Bolt II (S) (SS) | 4627 | 1-5/8 | Direct Pull<br>Tension -700 lbs<br>Torque 10 ft/lbs |
| | | ITW/Ramset Trubolt (S) (SS) | 1372 | 1-11/16 | |
| | | ITW/Ramset Dynabolt (S) (SS) | 1372 | 1-1/2 | |

4. Using a hammer, drive the anchor bolts into the holes drilled in the floor. Please allow enough room to mount the bracket, washer and nut.

# Installing the Subframe

✔ ***Note:*** *This procedure is not done on Block 2 systems. Skip to Installing the Brackets*

1. Remove the system panels.
2. Attach the anchor pin and the M10 washer onto the front subframe piece.
3. Lift the unit up on one side and support with a wooden support (a large roll of paper works well, too.
4. Slide the front subframe piece (the one with the flange) into the groove on the unit.
5. Slide the rear subframe piece into the rear of the STERRAD 100 Sterilizer frame. Make sure it slides into the hollow track of the frame.
6. Align the rear subframe with the holes used to mount the unit to the shipping pallet.
7. Fasten the rear subframe to the pallet mounting holes with the M8 screws, flatwashers and lockwashers. The two shorter M8 Allen

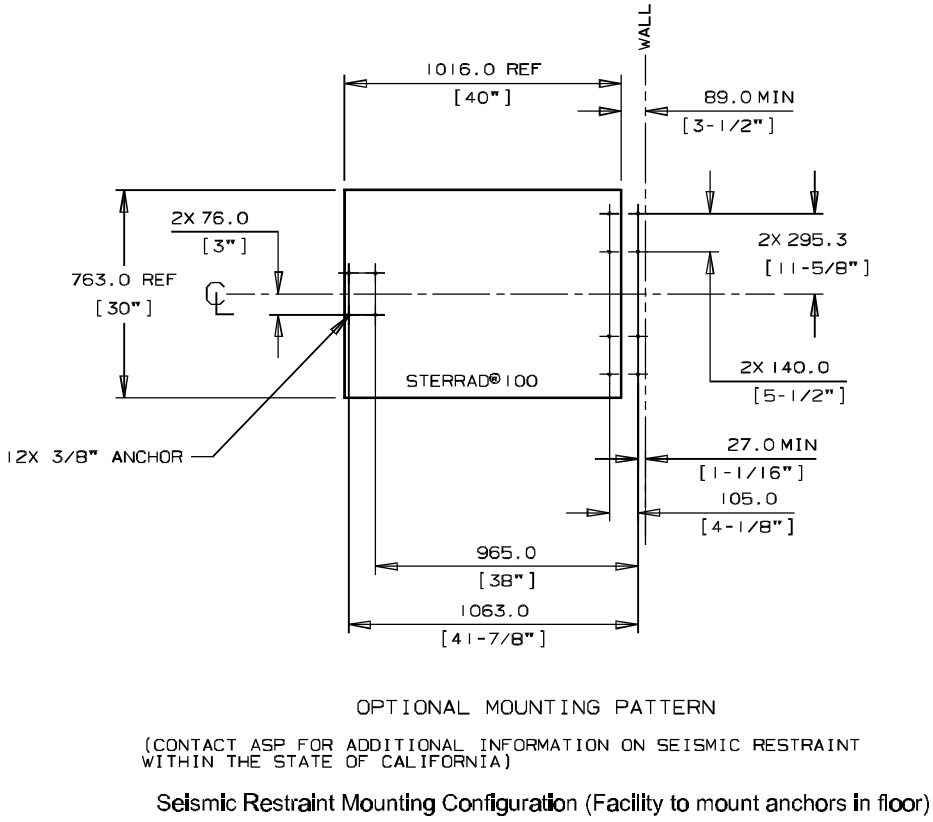
screws are used on the sides; the longer M8 Allen screw is on the rear of the unit. Leave the screws loose.

8. Fasten the rear and front subframes together with 5 M6 Allen screws flatwasher and lockwashers. Then tighten the M8 Allen screws.

9. Remove the support.

10. Tighten the 3 M8 screws.

# Installing the Brackets




Seismic Restraint Mounting Configuration (Facility to mount anchors in floor)

***Figure 11-5. Mounting Diagram***

1. Fasten the rear bracket onto the anchor bolts using the 3/8" wide flat washers and the nuts supplied with the anchor bolts.

2. Remove the rubber tipped spindles on the locating pins. Then loosen the 2 locating pins on the rear bracket. There are 4 mounting bolts on the bracket, loosen them with a 1/2" box wrench.

3. Loosely fasten the wheel guides onto the unit.

4. If the drilling template was used, it should be completely removed, including the tape holding it, by this point.

5. Move the STERRAD 100 Sterilizer so that the subframe channels align with locating pins on the rear seismic bracket.

6. Tighten the 4 mounting bolts on each locating pin. Tighten the wheel guides.
7. Pull the STERRAD 100 Sterilizer away from the rear locating pins. Ensure that unit pulls out easily. The level of the floor may affect the locating pins tightness into the channel.
8. Attach the front bracket to the anchor bolts using the 3/8" wide flat washers and the nuts supplied with anchor bolts.
9. Adjust the rubber-tipped bumpers to stop the unit when the anchor pins line up with the front bracket.
10. Raise or lower the anchor pin until it is at a height to fit in the front bracket key slot.
11. With the rear panel in place, adjust the rubber-tipped spindles until the sterilizer is stopped with the anchor pin in line with the front bracket. Tighten the spindles.
12. Raise the anchor pin until it barely clears the bottom of the key slot.
13. Using an Allen wrench, lower the front locking mechanism to the point where the STERRAD 100 Sterilizer is locked in place. (An M4 Allen wrench should work.)
14. Tighten the M10 jam nut.
15. Replace the panels.

# Preparing The System For Use

1. Open the accessories boxes shipped with the system. Remove all materials.
2. Install all the accessories in their proper locations. Make sure to wipe off any fingerprints or packaging material that may be present.
3. For STERRAD 100 S Systems set the cycle type according to the customer's needs.

## Phase Rotation

1. Start a cycle with no cassette and verify that the vacuum pump rotation is correct. Air blows out of the air mist filter housing when correct.

   ✔ ***Note:*** *If air is entering into the oil mist filter housing, immediately remove power from the system. Disconnect the power cord from the wall and correct the phasing of the power at the wall receptacle.*

2. If the phase is incorrect, the system generates a VACUUM SYSTEM INTERRUPTED message in 30 seconds and stops the vacuum pump.

# Initialization

The system must be initialized prior to use. The Master Reset procedures must be followed in the sequence given to accurately reset all system variables.

# Master Resets

The Master Resets are a series of steps used to initialize the system. They are also used for troubleshooting various error messages. The steps are: system reset, system variables reset, cassette collector box reset, date and time reset, and PM log reset.

## *System Reset*

⚠ **WARNING! Do not perform the master reset when a cycle is in progress. Perform only when the system is in the idle state.**

1. Remove any cassettes that may be in the injector pump. Discard according to accepted procedures.

2. Turn the main circuit breaker ON and perform a system reset by pressing **CANCEL** for ten seconds at the same time power is applied. The system sounds a beep tone when this process is completed and displays the date, software part number, and check sum.

## *System Variables Reset*

1. Enter the edit mode by pressing **START** and **CANCEL** at the same time. The system displays the current date information.

2. Simultaneously press and hold **START** and **OPEN DOOR** for 5 seconds. After 5 seconds, the system displays the system serial number.

3. Press **CANCEL** switch while in the serial number display. The system displays the total machine cycles field.

4. Write down the number of **TOTAL MACHINE CYCLES** displayed on the LCD, then reset the total machine cycles to 0.

5. Return to the active display by simultaneously pressing START and **OPEN DOOR** (the display switches to the edit date/time display). Then simultaneously press START and CANCEL to return to the active display.

   ✔ ***Note:*** *The reset is not accomplished until you exit the edit mode.*

6. Reenter the edit mode, as shown above and change the total machine cycles to the number you wrote down in step 4.

**SERIAL NUMBER XXXXX**
**OPEN (change) - CLOSE (accept)**

✔ ***Note:*** *The serial number is located on the frame behind the storage drawer.*

7. Press **CANCEL** and the system displays the serial number as follows:

8. A flashing cursor is displayed on the serial number field. To enter the serial number, press and hold **OPEN DOOR** until the desired number is selected. Alternate between the field numbers by pressing the **CLOSE DOOR** switch.

9. Simultaneously press **START** and **OPEN DOOR** (the display switches to the edit date/time display). Then simultaneously press **START** and **CANCEL** to return to the active display.

# Cassette Collector Box

1. Remove the cassette collector box from the box base assembly.

2. Reinstall the collector box after the system has signaled reset by a single beep tone (approximately 10 seconds).

# Date and Time

1. Enter the edit mode by pressing **START** and **CANCEL** at the same time. The LCD display shows the following:

**DATE = DAY, MM/DD/YY**
**OPEN(change) - CLOSE (accept)**

**DAY** is a three letter abbreviation for the day of the week e.g., WED; MM is the month, e.g., 03; DD is the numerical day, e.g., 25; and YY is the year, e.g., 95. A flashing cursor is displayed on the DAY field.

2. To change the displayed day, press **OPEN DOOR** until the desired day is selected. When the correct day is displayed, press CLOSE **DOOR** to move to the month MM field.

3. Press **OPEN DOOR** to change the MM, DD, and YY each in turn until the desired setting is displayed. Press **CLOSE DOOR** each time to move the cursor to the next field. After the YY is updated, the following message is displayed on the LCD:

**TIME=HH:MM:SS AM**
**OPEN(change) - CLOSE (accept)**

HH is the hour of the day, e.g., 09; MM is the minutes, e.g., 12; SS is the seconds, e.g., 43; AM represents after midnight and PM represents after noontime.

4. Press **OPEN DOOR** to change the HH, MM, and SS each in turn until the desired setting is displayed. Press **CLOSE DOOR** each time to move the cursor to the next field. After the AM/PM is updated, the current date is displayed.

5. After the desired date and time settings have been obtained, simultaneously press **START** and **CANCEL** to exit the month/time program.

# PM Log

1. Enter the edit mode by pressing **START** and **CANCEL** at the same time. The system displays the current date information. Press **CANCEL** to display the time information. Press **CANCEL** again to display the PM Log menu. The display looks like the following example:

**P.M. N: NEXT PM XXX**
**OPEN (reset) - CANCEL (next)**

For STERRAD 100 S Systems press OPEN DOOR and START to enter the edit mode. Then proceed with step 1 above.

✔ ***Note:*** *The cursor flashes on the N/Y field. The NEXT PM field displays the total remaining cycles before the system stops running cycles.*

2. Press **OPEN** to change the N default to Y (indicating maintenance has been completed). Verify that the **NEXT PM** field resets to the total allowable cycles (750) between maintenance intervals.

3. Press **CANCEL** (display moves to date), then press **START** and **CANCEL** at the same time. The system display returns to the ready state and prints the Maintenance Log.

# System Acceptance

The system must pass the product certification and biological acceptance procedure after installation. Select product certification procedures to go to the final steps needed to complete the installation . The biological acceptance is performed by the field service engineer and the system specialist prior to certifying the system for use.

# International System Configurations

Some systems are shipped with the final, language-specific configurations yet to be done. The final configuration information and parts are in a kit that is shipped with the system. The receiving organization finishes the system and returns the completion notification to ASP. The instructions for this configuration are as follows;

✔ ***Note:*** *This information is for configuring a system for international shipment only. These steps are not done on normal shipments within the U.S.A.*

## Attach Machine Label

1. Remove side panels and rear panels.
2. Locate the label that is in the correct language for the country receiving the unit.
3. Remove the rear cover of the AC enclosure.
4. Clean the lower left rear corner of the ac cover with 3m natural cleaner (or equivalent) and attached the chosen label (item 2) to the rear cover (item 6) as shown, so that it is readable. Press down firmly to remove any trapped air.

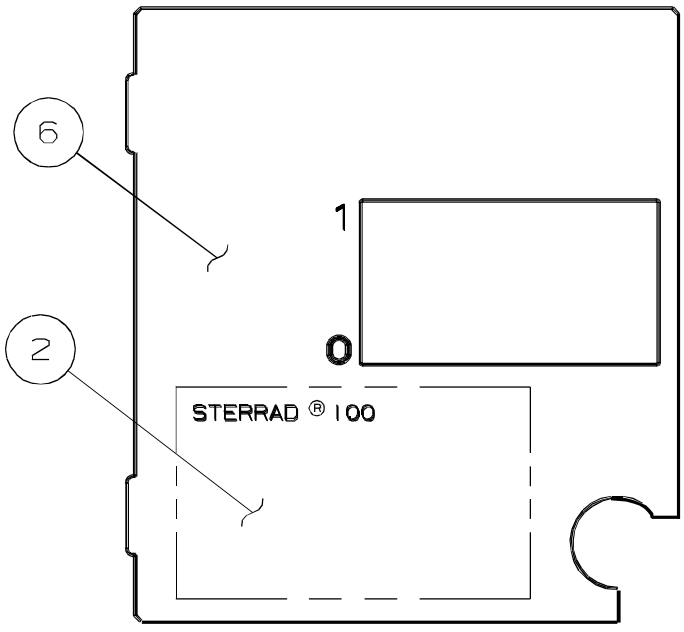



***Figure 11-6. Machine Label***

5. Attach the labeled cover to the rear of the AC Enclosure and secure by hooking the tabs into the slots and securing the PEM studs inside the enclosure with 2 each, M4 Flat washers and M4 Hex Lock nuts.

# Thermal Overload Relay

1. Attach the thermal overload relay to the AC interface enclosure.
2. Switch the mounting pins so that the two movable pins are set to outboard (widest) location.
3. Lift the clear plastic cover and set the overload to 3.6 amps, for the low voltage units (200 VAC, 208 VAC) and 1.8 amps for high voltage units (308 VAC, 398 VAC, 415 VAC).
4. Replace the clear plastic cover.

   ✔ ***Note:*** *Terminations ending in a clamping device should have only the stripped wire inside the clamp. The insulation should not be inside the clamp.*

5. Connect orange wire #80 to CR3-NC 95.
6. Connect orange wire #90 to CR3-NC 96.
7. Connect black wire #29 to CR3-T1.
8. Connect blue wire #30 to CR3-T2.
9. Connect red wire #31 to CR3-T3.
10. Install CR3 to CR2 by hooking CR3 into the cover of CR2 and inserting pins into CR2-T1, T2 and T3. Secure the terminal screws.
11. Attach the configuration board to the standoffs in the control enclosure and plug the connectors into the board.

# Power Plug

1. If not already installed, install a plug to the power cord for the correct voltage for your country. Connect as shown in the table below.

| Wire Number | Color and Number | P80-Connect |
|---|---|---|
| 1 | Black 1 | P80-X |
| 2 | Black 2 | P80-Y |
| 3 | Black 3 | P80-Z |
| 4 | Black 4 | P80-W |
| 5 | Green/Yellow | P80-Ground |

# Control Panel Bezel

1. Remove the plastic cover from the INSIDE of the clear plastic window. DO NOT remove the outer protective plastic overlay.

2. Press the control bezel into place on the front of the control panel until pins lock in the detents and the panel is flush with the front surface of bezel.

# Software Installation

**CAUTION: You MUST WORK AT A STATIC PROTECTED WORKSTATION, BE GROUNDED AT ALL TIMES, AND CONFORM TO ELECTROSTATIC CONTROL PROCEDURES. A WRIST STRAP CONNECTED TO THE FRAME OF THE MACHINE IS NOT GROUNDED UNLESS THE MACHINE IS PLUGGED INTO AN EARTH GROUND.**

1. Verify that the main circuit breakers are OFF.

2. Plug the machine to a grounded receptacle.

3. If you are setting up the system to operate in a language other than English, remove the microprocessor board, remove the EPROM and replace it with the appropriate language EPROM. Note the checksum listed on the EPROM. Place the removed EPROM in a static safe area.

**CAUTION! Pay particular attention to the orientation of the EPROM during insertion into its IC socket. Additionally, exercise care to ensure that the EPROM pins are not bent, broken, or otherwise damaged during insertion.**

4. Remove the “Remove Before Use” battery insulator between the battery and contact of the microprocessor board and affix it to the DHR.

5. Carefully attach the microprocessor board inside the to control enclosure.

6. Ensure that all boards are firmly seated in the card cage. Make sure the safety switch cannot be activated.

# System Reset

1. Turn the circuit breakers ON.

2. Press and hold **CANCEL** and at the same time close the control enclosure cover to activate the safety switch and turn the unit on.

3. Continue to hold **CANCEL** until the machine beeps.

4. Fully engage the enclosure cover screws and lock finger tight.

# Verify Voltages

1. Measure AC voltages for chamber and door heaters, control enclosure, RF generator, vaporizer and compressor. Refer to chart for version main line voltage and nominal voltages expected ±10% for each circuit.

| | | Main Line Voltage Version | | | | |
|---|---|---|---|---|---|---|
| | | 200 VAC | 208 VAC | 380 VAC | 398 VAC | 415 VAC |
| **Feature** | **Measure Input Voltage At** | | 208V-60 | 380V-50 | 380V-50 | 380V-50 |
| RF Generator | CB7 A-B | 200 | 220 | 220 | 220 | 220 |
| Chamber Heaters | CB6 A-B | 200 | 208 | 220 | 220 | 220 |
| Door Heaters | CB4 A-B | 200 | 208 | 220 | 220 | 220 |
| Control Enclosure | CB3 A-B | 120 | 120 | 120 | 120 | 120 |
| Vaporizer | J-89 pin 7 | 8 | 25 | 25 | 25 | 25 |
| Compressor | Utility J-83B | 120 | 120 | 120 | 110 | 120 |

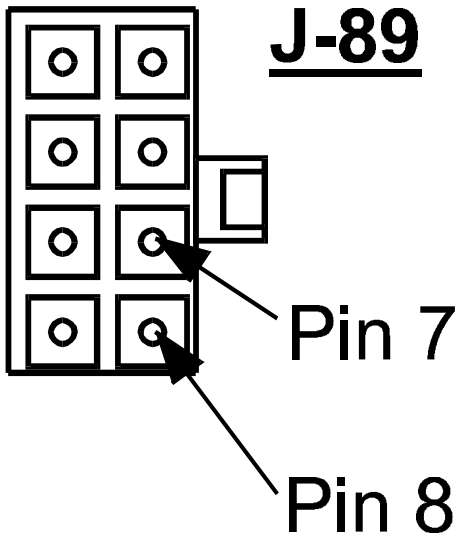



***Figure 11-7. Terminal Block***

# Install Printer Ribbon and Paper

1. Install the printer ribbon.
2. Install a roll of paper in the printer. Place the rest of the paper in the accessory box for shipment to the customer.

# Replace the Panels

1. Replace the system panels.
2. Perform a complete system certification as detailed in the STERRAD 100 S Service Guide.

# Perform BI Validation

1. Perform a complete BI validation and keep the records.

# Final Procedures

1. Fill out and fax the Configuration Certification Statement attached to these instructions.
2. If the unit is being shipped to another location, return it to the shipping crate and make sure it is correctly packed and secured.

## *Certification Statement Instructions*

Complete the certification statement included in the kit and fax it back after the configuration has been done. The system serial number, configuration kit number, LC number and country of origin MUST be included on the form for proper certification.

1. Enter the complete system serial number.
2. Enter the configuration kit number.
3. Fill in your name, ASP service location, country, date and phone/fax numbers.
4. Enter the LC number from the label.
5. Fax the entire certification back to the number provided on the certification sheet.

# Chapter 12

# *Planned Maintenance*

## Contents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Maintenance Schedule . . . . . 12-2
Level 1 Planned Maintenance . . . . . 12-4
Level 2 Planned Maintenance . . . . . 12-9

# Introduction

The STERRAD® 100 Sterilizer requires limited maintenance activity after 750 cycles (PM1) have been completed and more extensive maintenance after 1500 cycles (PM2). Maintenance is performed by ASP Field Service Engineers and by those customers who have received ASP-approved training in STERRAD System maintenance. PM 1 is performed at 750 cycles or 6 months, whichever comes first. PM2 is performed when the 1500 cycle interval is reached or at one year.

The cycle designation is being eliminated from many systems. PM1 or Level 1 and PM2 or Level 2 will soon be the only cycle/PM designations displayed.

The topics listed at the right provide detailed instructions for performing planned maintenance. When you have completed the applicable planned maintenance procedure, go to the procedures to certify system performance.

**Remember:** some STERRAD 100 Sterilizers may have older parts. Also, some parts and subsystems created for the **Block 2** machines are backwards compatible. Be sure you use the correct planned maintenance procedure. There is no particular PM procedure that is exclusive to the STERRAD **100 S** Sterilizer. All the procedures in this section apply to this version of the STERRAD System.

# Maintenance Schedule

| PM1 | PM2 | Task Description |
|---|---|---|
| Yes | Yes | Inspect Seismic Restraints |
| Yes | Yes | Replace Vacuum Pump Oil |
| Yes | Yes | Clean the Vaporizer Plate and Vaporizer |
| Yes | Yes | Drain Water From Air Storage Tank |
| Yes | Yes | Drain Pressure Regulator Moisture Trap |
| Yes | Yes | Drain Oil From Vacuum Pump Exhaust Filter Housing (not done on Block 2) |
| Yes | Yes | Replace Vacuum Pump Oil Filter (Leybold D16A only) |

| PM1 | PM2 | Task Description |
|---|---|---|
| Yes | Yes | Clean Air Filters/Panel Assemblies |
| No | Yes | Baratron Zero Shift Test |
| No | Yes | Replace the Catalytic Converter |
| No | Yes | Replace Pump Intake Filter |
| No | Yes | Replace HEPA Filter |
| Yes | Yes | Replace Exhaust Filters |
| Yes | Yes | Clean Door and Inside Chamber Assembly |
| No | Yes | Clean Platen Surface |
| No | Yes | Clean Door Seal and Replace Door Seal O-ring |
| No | Yes | Replace Upper Shelf Stops |
| No | Yes | Replace Electrode Spacers |
| Yes | Yes | Product Certification |
| Yes | Yes | Update PM Log |

# Level 1 Planned Maintenance

## Seismic Restraint Inspection

1. Disengage the system from the brackets, then move it out of the way. Make sure the bolts are tight, the brackets are in good shape, the flooring has not cracked or crumbled around the bolts. In the video, the demonstrator indicates all the points on the brackets that should be inspected.

2. If there is any problem, even if the brackets are only slightly loose, contact the proper facilities maintenance personnel at the customer site and make sure the brackets are properly tightened.

⚠ **CAUTION: DO NOT replace the system back on the brackets if they are not tight.**

## Clean the Vaporizer Plate and Vaporizer

1. Remove the vaporizer plate from the electrode.

2. Inspect it for wear and replace if necessary.

3. Rinse it off and dry it thoroughly.

4. Wipe off the vaporizer bowl and install the vaporizer plate.

## Replace Vacuum Pump Oil

✔ ***Note:*** *Always change the pump oil while the pump is warm to prevent condensation in the pump.*

1. Using an 8 mm Allen wrench, unscrew and remove the oil fill plug located at the top of the pump.

2. Remove the cap from the empty bottle in the kit. Place an oil absorbing cloth on the floor inside the machine as close to the drain valve hose as possible. Place the bottle on the cloth. Open the drain valve, place the hose in the bottle and drain the oil.

When draining oil from a Leybold D16A pump, insert the funnel in the empty bottle and place it on an oil absorbent cloth, under the valve at the rear of the pump. Open the valve to drain the oil.

3. After the flow has stopped, close the drain valve. Make sure the main circuit breaker is off before proceeding.

✔ ***Note**: If the used pump oil is excessively dirty, flush out the pump according to the Vacuum Pump Flush procedure*

4. Open a new bottle of pump oil and replace the cap with the oil filler cap (red tipped). Remove the red tip and cut about 1/6 to 1/4 inch off the cap tip so the oil flows freely.

5. Pour new pump oil (slightly less than one quart) into the oil fill port until oil reaches the raised line at the top of the sight glass (the MAX line on the Leybold D16A). DO NOT OVERFILL or attempt to empty the oil bottle. Some oil may remain in the bottle when the pump oil is at the specified fill level.

6. Re-cap and dispose of the drained oil and the oil absorbent cloth following standard hospital procedures.

# Drain the Air Storage Tank

The air storage tank is different on Block 2 machines.

1. Using a towel, cover the drain of the air storage tank, then slowly open the drain cock. On Block 2 systems, press the trigger to fill the bottle. Than empty the bottle and replace it.

2. When no further water flows from the drain, close the drain cock. Repeat steps 1 and 2 after 10 seconds. Clean up any areas splashed with water.

## *Drain the Air Storage Tank (Block 2)*

1. Locate the water collection bottle.

2. Press the air trigger and water flows from the tank into the collection bottle.

3. Remove the bottle, empty it and replace it.

# Drain the Pressure Regulator Moisture Trap

1. Place a towel below the pressure regulator trap prior to drainage.

2. Press upwards through the towel on the button at the bottom of the trap and permit water to escape.

# Drain the Exhaust Filter

The following procedure is only used on systems without the oil return system.

1. If accumulated oil is visible above the bottom of the drain hole (closed by the screw plug), remove the exhaust filter housing from the pump.
2. Place the funnel in the used oil bottle. Using a slot screwdriver, unscrew the plug and drain the oil into the bottle.
3. Replace the drain plug and reinstall the exhaust filter housing onto the pump.

   ✔ *Note: If the oil level is above the top of the lower filter, replace both filter elements.*

4. Dispose of the drained oil following standard facility procedures for lubrication oils.

# Replace the Vacuum Pump Oil Filter

This procedure is for the Leybold D16A vacuum pump only. The steps begun in this procedure lead directly into the next one: “Drain the Exhaust Filter.” You should complete this procedure before proceeding on to the next one. If you are servicing a Block 2 device, proceed to “Drain the Pressure Regulator Moisture Trap.” If you are servicing a pump without the oil return feature, go to “Drain the Exhaust Filter.”

1. Remove the screws and washers attaching the gas ballast valve to the oil casing. Remove the gas ballast valve.
2. Remove the oil filter from the gas ballast hole in the oil casing. Remove any dirt or corrosion found on the gas ballast valve prior to reassembly.
3. Install a new oil filter in the gas ballast hole in the oil casing. Reinstall the gas ballast valve.

# Clean Air Filters/Panel Assemblies

1. Lift out the filter over the fan. Gently clean with soap and water. Replace the filter with a new one if necessary.
2. Clean the fan (Block 1.8 only.)
3. Thoroughly dry the filter and snap it back in place.
4. Vacuum the screen on the outside of the RF generator. Carefully vacuum inside the sterilizer.

5. Vacuum the air filter on the rear panel on Block 2 systems.

6. Using a soft cloth dampened with soap and water, clean the exterior panel surfaces.

# Vacuum Pump Flush

This procedure should be used ONLY if the drained pump oil was very dirty. It is not a regular PM procedure.

1. If not already done, turn OFF the pump and reference the Replace Vacuum Pump Oil procedure to drain the used pump oil.

2. Disconnect the vacuum line from the intake tube, turn the main circuit breaker and vacuum pump ON, and pour clean pump oil into the intake tube while the pump is running.

**CAUTION: When flushing out the pump, fill it to capacity with pump oil.**

3. Allow the pump to run for at least 10 minutes, then turn the main circuit breaker OFF.

4. Drain the pump oil again as described in the “Replace Vacuum Pump Oil” procedure. If the pump oil used for flushing is still dirty, repeat steps 1-3 until the oil is clean.

5. Reconnect the vacuum line to the intake tube and close the drain valve.

6. Open a new bottle of pump oil and replace the cap with the oil filler cap (red tipped). Remove the red tip and cut about 1/6 to 1/4 inch off the cap tip so the oil flows freely.

7. Pour new pump oil (slightly less than one quart) into the oil fill port until oil reaches the raised line at the top of the sight glass (the MAX line on the Leybold D16A). DO NOT OVERFILL or attempt to empty the oil bottle. Some oil may remain in the bottle when the pump oil is at the specified fill level.

8. Replace the oil fill plug on the pump.

9. Dispose of the drained oil following standard customer procedures for lubrication oils.

# Update the Maintenance Log

1. Press **START** and **CANCEL** at the same time to enter the edit mode. The system displays the current date. Make sure the date is correct.

2. Press **CANCEL** to display the current time. Make sure the time is correct. Press the **CANCEL** again to display the maintenance log menu. The display looks like the following example:

| |
|---|
| **P.M. N: NEXT PM XXX**<br>**OPEN (reset) - CANCEL (next)** |

✔ ***Note:*** *The cursor flashes on the N/Y field. The NEXT PM field displays the total remaining cycles before the system no longer runs cycles.*

1. Press **OPEN** to change the N default to Y (indicating maintenance has been completed). Verify that the NEXT PM field resets to the correct number of cycles.

2. Press **CANCEL** (display moves to date), then press START and **CANCEL** at the same time. The system display returns to the ready state and the printer prints the maintenance log.

# Level 2 Planned Maintenance

When you have completed either planned maintenance procedure, follow the steps to certify system performance. Complete the procedures detailed in the Level 1 Planned Maintenance section and then continue with this section.

## Replace Exhaust Filters

✔ ***Note:*** *As of this publication, there are plans to install a catalytic converter in place of the standard exhaust filter. Removal and replacement of this converter is similar to the procedures shown below.*

1. Loosen the wing nut on the clamp holding the exhaust filter assembly on the vacuum pump, then open the clamp and remove the filter assembly. Be careful not to damage the O-ring seal.

2. If accumulated oil is visible above the bottom of the drain hole (closed by the drain plug), remove the drain plug using a slot screwdriver and drain the oil into an empty oil bottle using the funnel. Replace the drain plug.

3. Use a 4 mm Allen wrench to remove the four screws that hold together the upper and lower sections of the filter housing, then remove the upper section. Be sure the O-ring seal remains in the groove in the lower section.

4. Remove the two filter elements (one element in an Alcatel pump) and the small O-ring from the lower section of the filter housing and dispose of the filter elements according to hospital procedures, or, procedures permitting, in normal customer trash.

5. Using a lint free cloth, wipe all oil from the interior of the filter housing and the mating faces of the housing. Be careful not to unseat the mating surface O-ring seal.

6. Insert new filter elements and small O-ring, provided in the kit, in the lower housing section, with the fiber filter cartridge at the bottom and the charcoal filter cartridge at the top. Be sure that the O-ring seal on the bottom of the filter element is correctly seated.

7. Seat the upper housing section on the lower section and tighten the screws.

8. Replace the filter assembly on the vacuum pump, then fit and hand tighten the clamp.

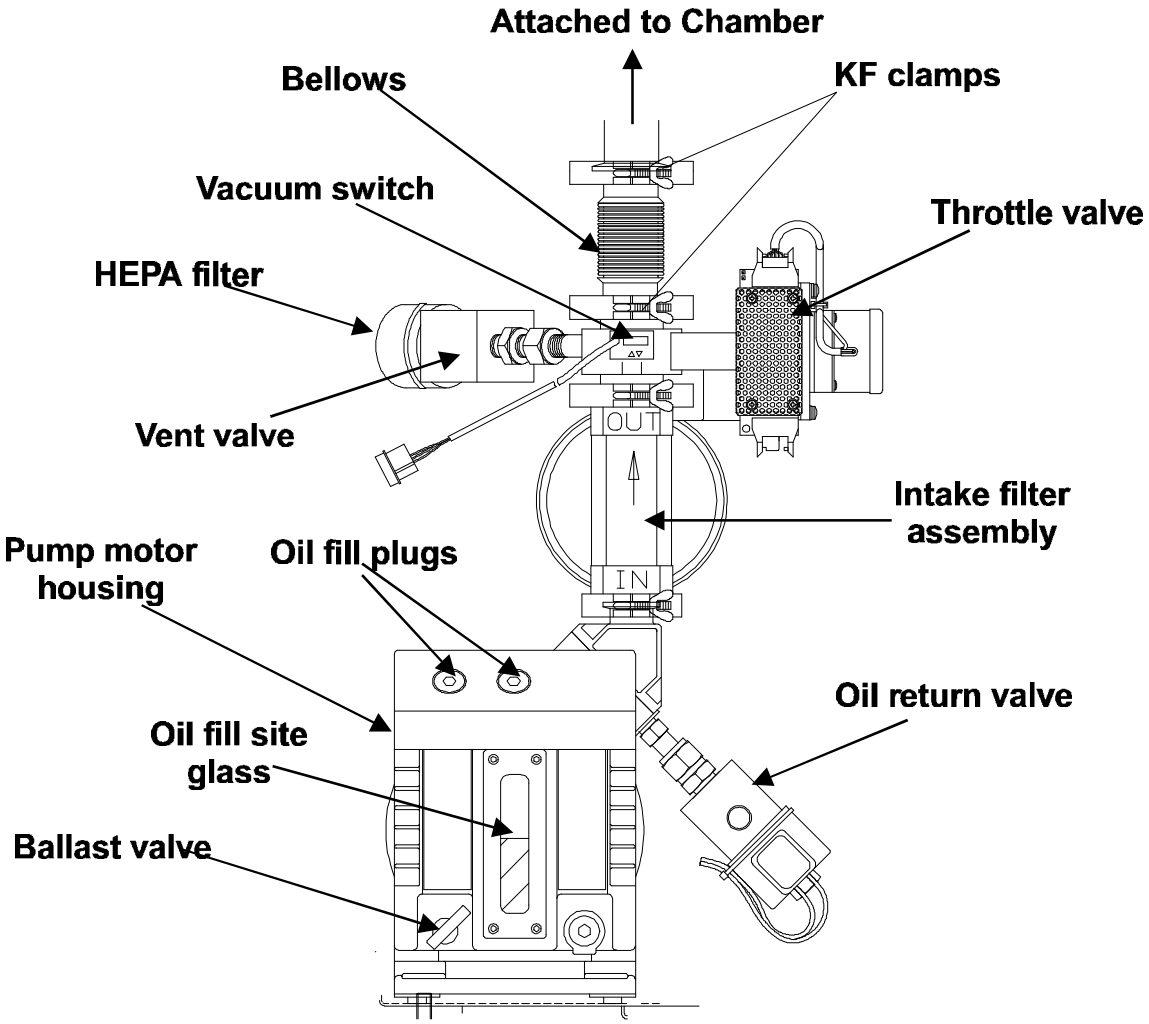


*Figure 12-1. Vacuum Pump*

# Replace the Catalytic Converter

The converter filter core is disposable according to standard facility procedures.

1. Unscrew the converter element from the top of the housing and discard it.

2. Loosen the wing nut on the clamp holding the exhaust filter assembly on the vacuum pump, then open the clamp and remove the filter assembly. Be careful not to damage the O-ring seal.

3. Use a 4 mm Allen wrench to remove the four screws that hold together the upper and lower sections of the filter housing, then remove the upper section. Be sure the O-ring seal remains in the groove in the lower section.

4. Remove the filter cap from the filter core and dispose of the filter core according to hospital procedures, or, procedures permitting, in normal customer trash.

5. Using a lint free cloth, wipe all oil from the interior of the housing and the mating faces of the housing. Be careful not to unseat the mating surface O-ring seal.

6. Insert a new filter element and replace the filter cap making sure the core is correctly oriented. Be sure that the O-ring seal on the bottom of the filter element is correctly seated.

7. Seat the upper housing section on the lower section and tighten the screws.

8. Install a new converter onto the housing.

# Replace Pump Intake Filter

1. Working from the left side of the filter, fit the filter housing wrench (supplied with system tool kit) onto the filter housing. Unscrew the housing by rotating the wrench counter-clockwise. Support the throttle valve so as not to place stress on the bellows. This prevents the housing from falling when it becomes free.

2. Remove the used copper mesh filter core from the housing (note the orientation of the filter). Place it in a plastic bag, and dispose of it in normal trash.

3. Insert a new copper mesh filter core into the housing. Write the PM date on the filter in the appropriate location. Lightly lubricate the housing O-ring with a thin film of vacuum grease.

4. Screw the filter housing containing the new filter into its normal position, then hand tighten. You may use the filter housing wrench, but do not over tighten the housing.

# Replace the HEPA Filter

1. Remove the HEPA filter body by rotating it counter-clockwise.

2. Remove the new filter from its package, then fasten it into its receptacle. Firmly hand tighten the filter body.

   ✔ *Note: Do not use Teflon tape to re-seal the filter.*

3. Discard the used filter according to hospital procedures.

# Door and Chamber Procedures

Cleaning the door and process chamber requires a number of steps including the removal of the RF electrode. The rear of the door should be cleaned during PM 1 and the chamber and electrode examined and cleaned if necessary during that PM.

PM2 procedures require that the electrode be removed and it and the chamber thoroughly cleaned. During PM2 the door seal O-ring must be replaced. It should be inspected and cleaned as needed during PM1.

The following three procedures, “Replace Door O-Ring Seal,” “Clean Door Surface Assembly,” and “Clean Chamber Assembly,” require that the front and top panels be removed and the door be moved to its service position.

The procedures listed below appear in the chapter detailing door procedures.

**693Opening the Door for Servicing**

**693Replacing the Door Seal O-Ring**

**693Door and Chamber Assembly Maintenance**

Upon completion of the chamber cleaning and reassembling the electrode and spacers, perform the steps below.

✔ ***Note:*** *Prior to tightening the screws on the front panels on a Block 1.8 system, verify the alignment of the cassette through the cassette door by inserting a cassette.*

1. Reinstall the panels and reconnect the cassette door assembly cable.
2. Return the door to the normal position. Clean the rear surface of the door with deionized water.
3. Close the chamber door. Close the storage drawer.

# Clean Platen Surface

1. Clean the surface of the injector pump platen with deionized water and a lint free cloth.

# Update the Maintenance Log

1. Press **START** and **CANCEL** at the same time to enter the edit mode. The system displays the current date. Make sure the date is correct.

2. Press **CANCEL** to display the current time. Make sure the time is correct. Press the **CANCEL** again to display the maintenance log menu. The display looks like the following example:

   **P.M. N: NEXT PM XXX**
   **OPEN (reset) - CANCEL (next)**

   ✔ ***Note:*** *The cursor flashes on the N/Y field. The NEXT PM field displays the total remaining cycles before the system no longer runs cycles.*

3. Press **OPEN** to change the N default to Y (indicating maintenance has been completed). Verify that the NEXT PM field resets to the correct number of cycles.

4. Press **CANCEL** (display moves to date), then press START and **CANCEL** at the same time. The system display returns to the ready state and the printer prints the maintenance log.

# Chapter 13

# Product Certification

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# Introduction

This section contains the procedures necessary to certify system performance of the STERRAD® 100 Sterilizer and the STERRAD **100 S** Sterilizer. Product Certification is an important procedure that should follow various activities performed in the field regarding the sterilization system. If the certification procedures indicate that adjustment is needed, you should perform the adjustments according to the specific calibration procedures shown in this guide.

Some of the activities requiring certification are:

- **Planned Maintenance**-Verify system performance following both PM1 and PM2 services. Be sure to complete the appropriate field service reports.
- **Installation**-Verify system performance following uncrating, set-up, and initial system operation.
- **Removal and Replacement**-Verify system performance following removal and replacement of subsystems. The Product Certification may only need to be done to the particular subsystem replaced.
- **Routine Inspection**-Verify system performance as part of the routine inspection associated with the ALLIANCE(SM) Service Program contracts. Be sure to complete the appropriate field service reports.

Remember: when you see the STERRAD icon, it means that the procedure, or steps within the procedure being described are for a different configuration of the subsystem or part. The configuration differences are for **Block 2** and STERRAD **100 S** Systems. It is important to note that Block 1.8 systems can be upgraded to run the STERRAD **100 S** Software. If that has been done, perform the Block 1.8 tests unless the instructions indicate to do otherwise.

Also note, some parts in the field pre-date standard Block 1.8 devices described in the “About this Guide” section. Be sure you use the correct procedure for the equipment you are servicing.

## *Service Action Table*

Use the product certification procedures to verify sterilizer performance whenever the service actions listed in the following table are completed.

| Service Action Performed | Product Certification Test Requirements |
|---|---|
| PM 1 | All tests (except Baratron Zero Shift Test) |
| PM 2 | All tests |
| All Service | Leak back test RF power measurement door and chamber temperature injection and diffusion pressure after 20 minutes (diffusion pressure does not apply to STERRAD **100 S** Systems). |
| Replace vacuum subsystem components | Leak back test RF power measurement door/chamber temperature manual injection procedure (run complete cycle). |
| Replace RF subsystem components | Leak back test RF power measurement door and chamber temperature. |
| Replace AC enclosure components | Leak back test RF power measurement door and chamber temperature door /chamber heater voltage injector valve heater voltage. |
| Replace pneumatic components | Pneumatic pressure switch. |
| Replace controller or components | Power supply check A/D set point door and chamber temperature. |
| Replace injection system components. | Injector valve height injector pump floating guide cassette optics leak back test Leak back test RF power measurement door and chamber temperature. |
| Replace door sensors | Door operation and complete cycle |
| Replace printer | Verify editor function and perform complete cycle |

# Certification Procedures

Be sure to perform all certification procedure in sequence. This is particularly important for the heater voltages and temperatures.

- System Preparation
- Power Supplies Verification
- Analog to Digital Set Point Verification
- High-Low Pressure Range Divider Voltage Verification
- Baratron Zero Shift Test
- RF Power Test
- Leak Back Test
- Compressor Pressure Switch Verification
- Cassette Optics Test
- Injector Pump Floating Guide Check
- Master Reset
- Heater Voltages and Temperatures
- Vaporizer Heater Voltage Verification
- Door Temperature
- Chamber Temperature
- Block 2 Door and Chamber Temperatures

## System Preparation

1. Remove the access panels from the control enclosure and apply power to the enclosure by enabling the safety interlock.

# Compressor Pressure Switch Test

This test verifies the pneumatics compressor starting and shut off pressure.

1. While pressing upwards on the button at the bottom of the pressure regulator moisture trap, monitor the pressure gauge.
2. Verify the compressor starts at 60 PSI ±3 PSI.
3. Verify the compressor shuts off at 80 PSI ±3 PSI.

# Power Supplies Test

This test verifies the performance of the power supplies.

1. Connect DMM leads to the terminal block located on the connector distribution board as indicated in the tables below:

**Block 1.8 with/without 100 S Upgrade**

| Voltage to be Measured | Positive Lead | Negative Lead | Acceptable Range |
|---|---|---|---|
| +5.2V | Terminal 2 | Terminal 1 | +5.18 to +5.22 |
| +12.85V | Terminal 3 | Terminal 1 | +12.80 to +12.90 |
| -12 V (REF) | Terminal 4 | Terminal 1 | -12.0 VDC ±10% |

**Block 2.0 with/without 100 S Upgrade**

✔ *Note: Test points are very close together so make sure you use the proper connections. Measure voltage at the connector distribution board test point. Adjust trimpots on PS1 (rear, lower point) for pin 2 and PS2 (front, raised point) and for pin 3 as shown in the table below.*

| Voltage to be Measured | Positive Lead | Negative Lead | Acceptable Range |
|---|---|---|---|
| +5.2 VDC ±0.02 VDC | Pin #3 | Pin #1 | +5.18 to +5.22 VDC |
| +12.85 VDC ±0.05 VDC | Pin #4 | Pin #1 | +12.80 to +12.90 VDC |

| Voltage to be Measured | Positive Lead | Negative Lead | Acceptable Range |
|---|---|---|---|
| -12 VDC (REF) | Pin #2 | Pin #1 | -12.0 VDC ±10% |

2. Connect DMM leads to +12 V and ground at the pressure transducer (Baratron). Verify +12 V (REF) is within specifications. The Block 2 voltages can also be measured at the connector.

{b

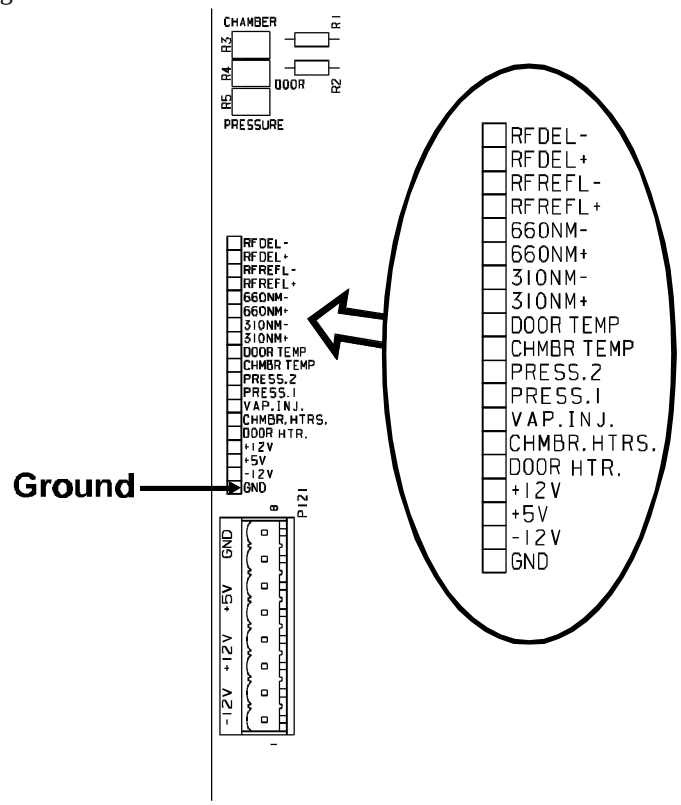


***Figure 13-1. Power Supplies Test***

# Analog to Digital Set Point Test

1. Remove the A/D board, and install a 40 pin IC test clip on IC-8. Install an extender board in the A/D board slot and plug the A/D board into the extender. Apply power to the enclosure by enabling the safety interlock, and allow 15 minutes for the system to stabilize. (System stabilization is not necessary for Block 2 It is vital for systems using the old style A/D PCBs.)

   ✔ *Note: On newer boards the test points and adjustment pot are located at the edge of the board.*

2. Measure the voltage between IC-8 pin 39, and IC-8 pin 36. Verify the voltage measured is 2.048 VDC ±0.005 VDC.

3. For Block 2 (and upgraded Block 1.8 systems), measure the voltage between test point 1 (+) and test point 2 (-). Adjust trimpot R1 on the A/D board to 2.048 VDC, ±0.005 VDC. Apply a small amount of Glyptal to the trim pot to lock adjustment.

4. Remove the extender board and reinstall the A/D board.

# High-Low Pressure Range Divider Voltage Verification

1. Open the control enclosure and interrupt power to the enclosure by defeating the safety interlock. Remove the microprocessor board, and insert the AutoTest board.

2. Remove the connector from the MKS Baratron pressure transducer, and attach the voltage divider adjustment tool to the harness connector.

3. Apply power to the enclosure by enabling the safety interlock.

4. Perform the Analog Test from the AutoTest procedures.

5. If the voltage is not within specifications, adjust the bottom trim pot (R7) on the connector distribution board until the indicated voltage on the is correct according to the AutoTest procedures. Adjust trim pot R5 on Block 2 devices.

6. Remove the adjustment tool and reconnect the cable to the pressure transducer.

# Baratron Zero Test

✔ *Note: This test should be performed as part of PM2.*

1. Remove the bellows, filter, vent valve, vacuum switch and throttle valve from the vacuum subsystem.

2. Connect the T-piece to the KF-25/16 adapter (D16B pump) or the KF-40/16 adapter (D16A pump). See the Baratron Test diagram.

3. Disconnect the capacitance manometer (Baratron) from the chamber and attach it to one side of the T-piece.

4. Using an extension harness, connect the one end to the Baratron harness and the other end to the Baratron.

5. Install the Thermovac TM-20 (TR-211) vacuum gauge head to the center of the T-piece. Let the TM-20 warm up for about 15 minutes prior to use.

6. Turn on the TM-20, the display indicates 7.6 X 10+2 Torr (760 Torr). In the video clip, the demonstrator indicates the major parts of the TM-20 that need to be assembled.

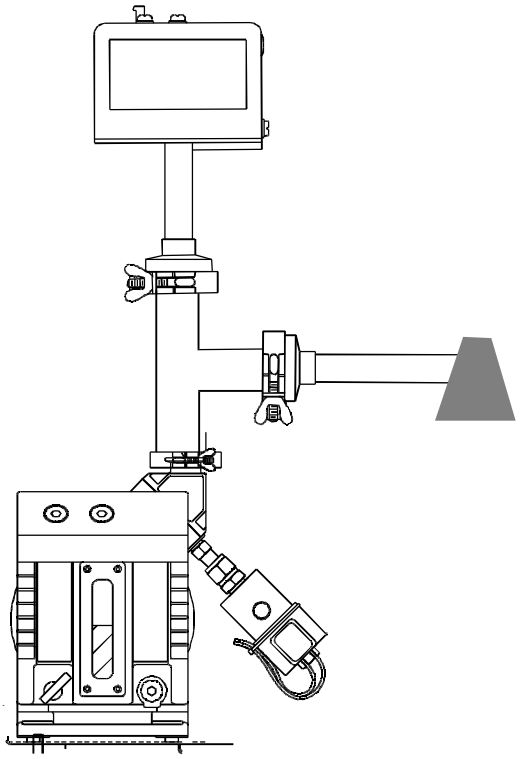

***Figure 13-2. Baratron Test Equipment***

7. Install the AutoTest board and start the vacuum RF test.
8. During pump down, the pressure display on the TM 20 drops below 10 mTorr within 15 minutes.
9. During the test, the pressure displayed on the LCD should remain stable. This is the value of the Baratron. The zero pot should be adjusted to equal the value measured by the TM-20 vacuum gauge.
10. After completion of the test remove the gauge, re-assemble the vacuum pump.
11. Perform a complete leak back test. If the test fails, inspect the system for leaks.

# Injector Pump Floating Guide Check

1. The purpose of this test is to ensure that the cassette tracks freely through the pump, is under control at all points, and that the cassette bars are a constant dimension from the sensor tip.

2. Inspect the floating guides and make sure they are clean and contain no build-up of H2O2 preservative. If build-up is observed, clean the guides before continuing with the test.

3. Insert a cassette so that the leading edge is approximately 20 mm past the drive roller. Start the cassette adjustment test and press START on the control panel.

4. Watch the cassette as it travels on to the rear portion of the injector pump. Observe the gap between the floating guide and the cassette. The gap should be less than 0.5 mm. Press CLOSE DOOR to stop cassette from traveling.

5. If a larger gap exists, perform the floating guide adjustment procedure in Chapter 5.

# Cassette Optics Test

1. Open the control enclosure and interrupt power to the enclosure by defeating the safety interlock.

2. Remove the CPU board, and install the AutoTest board.

3. Apply power to the enclosure by enabling the safety interlock.

4. Start the AutoTest procedure.

5. Remove the AutoTest board at the completion of the test.

# RF Power Test

1. Disconnect the RF (COAX) cable from the RF generator.

2. Connect the cable to output connector of the 4412 Bird Watt Meter.

3. Connect a test cable from the RF generator to the input end of the 4412 Bird Watt meter.

**CAUTION: Make sure the cable is securely connected so that it does not short across the enclosure.**

4. Set up a Bird Watt meter on the X10 kilowatt scale. The slug arrow should point towards the RF match. Start the Vacuum RF Test in AutoTest. At this point you may continue the entire RF Power Test using the AutoTest Vacuum_RF menu.

# Leak Back Test

1. Perform the Leak Back Test in AutoTest.
2. Verify system leak back rate is less than 25 mTorr per minute.
4. If the test fails, inspect the system for leaks

# Master Reset

**CAUTION: Do not perform a master reset when a cycle is in progress. Only perform this procedure when the system is in the idle state.**

1. Defeat the safety interlock, remove the AutoTest board and install the system microprocessor board.
2. Apply power to the enclosure by enabling the safety interlock and pressing CANCEL simultaneously.
3. Continue to hold CANCEL until you hear the beep signal, then release.
4. Remove the cassette collection box. Wait for the beep tone and then reinstall the empty box.

# Heater Voltages and Temperatures

Following are procedures for testing the vaporizer heater voltage, the door heater temperature and the chamber heaters temperatures. Be sure to perform these procedures in the sequence given.

- Temperature Continuity Check
- Vaporizer Heater Voltage
- Door Temperature
- Chamber Temperature
- Block 2 Door and Chamber Temperatures

# Temperature Continuity Check

1. Disconnect the connectors for the vaporizer heater, the top, bottom and rear chamber heaters, and the door heater.
2. Using an DVM, verify the impedance and continuity of each heater.
3. Reconnect the heaters and proceed with the heater tests.

# Vaporizer Heater Voltage

1. Insert a cassette and start an empty chamber cycle.
2. Connect a DMM to the injector valve vaporizer heater connector. Verify the voltage measured is between 20-24 VAC during the first 5 minutes of the vacuum cycle.

# Door Temperature

1. Check the voltage on the door heater to verify that it is powered, and after a few minutes, verify by touch that the heater is functioning.
2. With a Fluke model 80T-150U, or equivalent, measure the door temperature at the back surface of the door in the lower right corner (when viewed from the front), 40 mm in from the edge.
3. During the diffusion stage, the door temperature should measure 46° C ±2°C.

4. For STERRAD **100 S** Systems, measure the temperature during the second injection stage.

# Chamber Temperature

1. Check the voltage on each of the three heaters to verify that they are powered, and after a few minutes, verify by touch that each of the heaters is functioning.

✔ *Note: The voltages depend on the type of unit being tested: 208 machines have 120V; 380 have 220 V and 415 have 240V.*

2. With a Fluke model 80T-150U, or equivalent, measure the chamber temperature adjacent to the thermistor located by the chamber rib.
3. During the diffusion stage, the chamber temperature should measure 46°C ±2°C.

4. Check temperature at rear and side of unit to verify that the chamber is between 42-50°C.

✔ ***Note:*** *For STERRAD* **100 S** *Systems measure the temperature during the second injection stage.*

## *Door and Chamber Temperatures (Block 2)*

1. Begin an empty chamber cycle.

2. Check the voltage at chamber heater connector P115. It should read 208 ±10% VAC. Check the voltage at door heater connectors P95. It should read 208 ±10% VAC. (These are nominal readings only to check shorts and opens).

✔ *Note:* **Block 2** *has 4 J-type thermocouples connectors. T/C 1 and T/C 2 are located at the right rear of the frame near the chamber. T/C 3 and T/C 4 are located on the lower right of the door.*

✔ *Note: For STERRAD* **100 S** *Systems measure the temperature during the second injection stage.*

3. Connect an Omega thermocouple tester (J-type) to T/C 1. Verify that the temperature measured during the diffusion stage is 42-50º C. Repeat for all thermocouples listed in the note above.

# Appendix A

# Technical Data

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# Overview

This section contains the specifications or technical data for the STERRAD® 100 Sterilizer. The selections feature the characteristics of all the configurations serviceable in the field up to the point this manual was written. Newer configurations are dealt with by service bulletins. Make sure you have current service and technical bulletin information before servicing any STERRAD sterilization equipment.

# Physical Specifications

| **Physical Characteristics** | |
|---|---|
| Dimensions | 765 mm W x 1660 mm H x 1020 mm D (30² W x 65.5² H x 40² D) |
| Appearance | FED color specification #26408<br>**Block 2** has a custom color |
| Weight | Approximately 325 Kg (700 lbs) |
| Shipping Weight | Approximately 350 Kg (750 lbs) |
| **Chamber** | |
| Volume | 173 liter (6.1 cubic feet) |
| Usable Volume | 100 liter (3.5 cubic feet) |
| Inside Length | 810 mm (32 inches) |
| Inside Diameter | 510 mm (20 inches) |

| **Shelving** | |
|---|---|
| Upper Shelf Dimension | 700 x 425 mm (28² x 17²)700 x 426 mm ( 28² x 16.7²) Block 2 |
| Lower Shelf Dimension | 760 x 425 mm (30² x 17²)760 x 325 mm (30² x 12.8²) Block 2 |
| Shelving Strength | 25 kgs (55 lbs) uniformly distributed per shelf |
| Shelving Materials | Passivated stainless steel and polyethylene |
| Top Shelf Adjustment | Removable. Shelf slides out of chamber to one half of its length. |
| Bottom Shelf Adjustment | Fixed |

# Environmental Conditions

| **Transport and Storage** | |
|---|---|
| Ambient Temperature | -40 to +70° C (50 to 104° F) |
| Relative Humidity | 10 to 100% including condensation |
| Atmospheric Pressure | 500 hPa to 1060 hPa |
| **Operation** | |
| Ambient Temperature | +10 to 40° C (50 to 104° F) |
| Altitude | -100 to 3000 m above msl (-330 to 10,000 ft above msl) |
| Relative Humidity | 0 to 95% RH, non-condensing |

| | |
|---|---|
| Atmospheric Pressure | 700 hPa to 1060 hPa |
| Surface | The floor at the installation is flat and level to ± 5 mm/M. |

| | |
|---|---|
| Installation Space Requirements | In operation, the system shall not be placed closer than 50 mm (2 in) to a wall at the rear and/or sides of the system. The system should be installed in a space of sufficient size to permit access to all four sides of the system when the system is rolled away from the rear and/or side walls a distance of 3 meters (10 ft), the extent of the power cord. Service access should allow for a minimum clearance of one meter (3 ft) on all sides of the system. |
| Mobility | The sterilizer is designed to be free standing and self contained with no required connections other than the electrical power cord. The sterilizer is equipped with wheels that allow it to be rolled easily from one location to another. The unit is also equipped with adjustable feet at the front of the unit if leveling is required. |

# Electrical Requirements

| **Voltage Specification** | |
|---|---|
| **IMPORTANT WARNING!** | Prior to relocating the sterilizer to a new power source, electrical phase rotation should be checked by a qualified technician. Failure to verify phase rotation may cause damage to the system and void the warranty. |
| 208V 60 Hz Power200V and 208V (**Block 2**) | For versions employing 208V, 60 Hz power, the sterilizer requires a NEMA L21-20 five wire grounding twist lock outlet attached to a dedicated 20 Amp 3 phase 208 Volt circuit with separate neutral and ground conductors. |
| 380 - 415V 50 Hz Power380V, 398V and 415V (**Block 2**) | The sterilizer requires a five wire grounding outlet attached to a dedicated 10 AMP, 3 phase, 380V circuit with separate neutral and ground conductors. |
| Phase Rotation | The system requires CBA phase rotation. The phase rotation is adjusted to match the system requirements at installation. |

| | |
|---|---|
| Power Calculation | Phase A 228 W-hours per cycle<br>Phase B 158 W-hours per cycle<br>Phase C 177 W-hours per cycle<br>Total 563 W-hours per cycle |
| Heat Generation | 1919 Btu per cycle |

# Heater Impedance

| Heater Location | Type | Impedance |
|---|---|---|
| Door | Block 2 | 190 Ohms |
| Chamber | Block 2 | 100 Ohms |
| Chamber top | Block 1.8 | 50 Ohms |
| Chamber bottom | Block 1.8 | 50 Ohms |
| Chamber rear | Block 1.8 | 190 Ohms |
| Door | Block 1.8 | 50 Ohms |

# Standards

| Agency | Description |
|---|---|
| EPA/OSHA | Maximum hydrogen peroxide ambient concentration: less than 1 PPM (8 hour weighted average). Tested average was 0.014 PPM. |
| NEC | The system meets all applicable National Electrical Code (US) standards. |
| VDE | VDE 871 certification. Report Number 91287V. |
| FCC | The system meets all FCC Class A, IEC CISPR requirements. |
| CSA | All electrical components are CSA approved. **Block 2** meets CSA requirement certificate number LR-103178-1 |
| IEC | IEC 601-1 Medical Equipment Safety Certification. File Number 112 MT 14880. |
| LA | City of Los Angeles Electrical Testing Lab Approval. Application Number 330300 |
| TUV | **Block 2** meets TUV requirements. |
| NSTA | The shipping container includes an integral pallet which meets US and International standards. The package provides protection for the machine to pass NSTA tests ASTM D-999 and FED-STD-101. |
| NRTL/C | **Block 2** meets UL standard 1262-Laboratory Equipment. |

# Product Version

| Product | Voltage | Frequency |
|---|---|---|
| 00-10100-001 | 208 VAC | 60 Hz |
| 00-10100-002 | 380-415 VAC | 50/60 Hz |
| 10100 Block 2 | Configurable | 50/60 Hz |

Each of the above products could have a stand-alone configuration kit. The part number for the configuration kit is 05-02800-0-XXX. For **Block 2** it is 05-02378-0-XXX. XXX is defined below.

| Version | Description |
|---|---|
| 010 | USA |
| 020 | Germany |
| 030 | France |
| 040 | Australia |
| 050 | Canada (English) |
| 051 | Canada (French) |
| 060 | Chile |
| 070 | Japan |
| 080 | South Africa |
| 090 | Austria |
| 100 | Italy |
| 110 | Benelux (Eng) |
| 111 | Benelux (Fr) |
| 112 | Benelux (Dutch) |
| 113 | Benelux (Ger) |

| Version | Description |
|---|---|
| 120 | Sweden |
| 130 | UK |
| 140 | Ireland |
| 150 | Switzerland (German) |
| 151 | Switzerland (French) |
| 152 | Switzerland (Italian) |
| 160 | Spain |
| 170 | Taiwan |
| 180 | Middle East |
| 190 | Columbia |
| 200 | Argentina |
| 210 | Mexico |
| 220 | Uruguay |
| 240 | Korea |
| 250 | Thailand |
| 260 | Hong Kong |
| 270 | Malaysia |
| 280 | Brazil |
| 290 | Venezuela |
| 320 | Singapore |

# Thermocouples

| Thermocouples | Measurement | Location |
|---|---|---|
| TC1 | 42°-50° C | Top of chamber behind injector valve |
| TC2 | 42°-50° C | Bottom of chamber near door |
| TC3 | 42°-50° C | Middle of door |
| TC4 | 42°-50° C | Edge of door |

# Tools and Test Equipment

The following items may be needed to perform the service procedures for the STERRAD 100 Sterilizer. Included are parts needed for chamber heater and feedthrough replacement.

| Manufacturer | Model or ASP Part Number | Where Used |
|---|---|---|
| Metric Tool kit | Local Supplier | All maintenance |
| Digital multimeter (DMM) accurate to 3 decimal places | Fluke 87 or equivalent | Product certification and calibration |
| Temp. Probe -50`C to +150`C | Fluke 80T-150U | Product certification and calibration |
| RF Meter with 50 Ohm impedance | Bird 4412 | Product certification |
| Service Test PWA | 04-03295-0-001 | Repairs product certification and calibration |
| Autotest PWA (available to ASP Service Personnel only) | 04-02397-0-001 | Repairs product certification and calibration |
| Adjustment Tool Baratron | 35-02211-001 | Product certification and calibration |
| Ball driver | 35-02716-011 | Planned maintenance |

| Manufacturer | Model or ASP Part Number | Where Used |
|---|---|---|
| **Block 2**. Long arm Allen wrench, metric | 35-01249-205<br><br>35-01249-108 | Planned maintenance |
| **Block 2**. Vaporizer spanner wrench | 35-03000-001 | Repairs |
| **Block 2**. Omega Thermometer with J-type thermocouple cable | Omega HH-81 | Product certification and calibration |
| Wrench, Filter Housing | 35-01259-001 | 1500 cycle PM |
| Extender PWA (not used on **Block 2** systems) | 35-02424-001 | Product certification and calibration. |
| Cassette Gap Tool | 35-02447-001 | Repairs, product certification and calibration. |
| Door Align Tool T-2270 | 35-02425-001 | Door alignment/ calibration |
| Door Align Tool T-2266 | 35-02426-001 | Door alignment/ calibration |
| Vaporizer Cap Spanner Assembly | 35-02426-001 | Operator maintenance |
| Silicone Primer | 37-00686-015 | Heater installation |
| Silicone Adhesive | 37-00686-008 (consists of RTV and DBT catalyst) | Heater installation |
| Feedthrough Kit | 90-03701-001 | Feedthrough replacement |
| Baratron Zero Shift Test Kit | 35-04264-001 | Baratron testing |

# Appendix B

# AutoTest

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# Introduction

This section is about the AutoTest board. The AutoTest Board enables service personnel to perform calibration and product certification procedures more easily. The procedures featured are those procedures that are benefited by using the AutoTest board. Some procedures are the same as those used with the Service Test board, others automate manual service test procedures.

AutoTest is menu driven and selections are made from the control panel display LCD by using the function keys on the control panel. The use of the function keys as displayed on the LCD is as follows:

- **START**-Press **START**.
- **CANCEL**-Press **CANCEL** .
- **LONG CANCEL**-Press and hold **CANCEL** for 3 seconds.
- **OPEN-**Press **OPEN DOOR.**
- **CLOSE-**Press **CLOSE DOOR**.
- **LONG CLOSE-**Press and hold **CLOSE DOOR** for 3 seconds.

## Overview

AutoTest has a long series of selectable tests. If a test shows an anomaly, you should determine the source of the problem, fix it according to the corrective actions and then restart the test. Some of the tests contained in the firmware are not performed. They are presented for reference only. Differences in configurations are shown where applicable. The tests are presented as follows:

## Test Name

This heading indicates what subsystem is being tested.

### Display

Shows the messages displayed on the LCD read-out.

**SAMPLE LCD Display**

### Action

Provides instructions for completing the tests and certifications required. Text in **Bold** indicates the switch to press to perform the test or continue to the next test. Pressing **START**, **CANCEL** or LONG CANCEL usually advances to the next text or display. Press **LONG CANCEL** to skip or exit out of a test or menu.

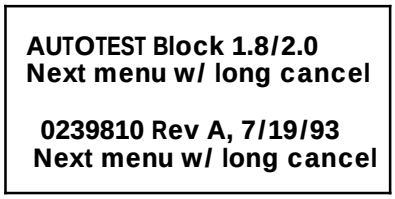
### Corrective Action

This information is a list of things to do if the system is not working correctly.

- Perform corrective action in the sequence given until failure is found then restart test sequence given.
- Do not replace items if they are not the cause of failure.
- Repeat any test that shows an anomaly, or where you adjust or replace any component or part.

# User Interface Tests

### Initial Start-Up Display




### Action

- Verify that software part number and revision are correct.
- Verify display is working and has proper contrast.
- Adjust contrast with R1 pot on rear of display board.
- Press a **LONG CANCEL**.

### Corrective Action

- Verify connections.
- Check 5 VDC power supply and replace if necessary.
- Replace CPU board.
- Replace ribbon cable.
- Remove and replace control panel assembly.
- Replace digital I/O board.
- Replace control enclosure (perform only after all other solutions have failed).·

### Display

| |
|---|
| **EXIT THIS Menu W/ LONG CLOSE** |

### Action

Press a **LONG CLOSE.**

### Display

| |
|---|
| **OUTPANEL W/ START or NEXT Menu W/ LONG CANCEL** |

### Action

To repeat the test, press the **START** key; otherwise press a **LONG CANCEL.**

## *Membrane Switch Test*

Each test requires that you press the membrane switch specified in the display.

**Display**

| |
|---|
| **INPANEL W/ START. or<br>NEXT Menu W/ LONG CANCEL** |

**Action**

Press **START.**

**Display**

| |
|---|
| **CHECK CANCEL SWITCH<br>PRESS CANCEL** |

**Action**

Press **CANCEL**

**Display**

| |
|---|
| **CANCEL SWITCH OK!<br>PRESS CLOSE SWITCH** |

**Action**

Press **CLOSE DOOR.**

**Display**

| |
|---|
| **CLOSE SWITCH OK!!<br>PRESS OPEN SWITCH** |

**Action**

Press **OPEN DOOR.**

**Display**

| |
|---|
| **OPEN SWITCH OK!!<br>PRESS LONG CLOSE TO EXIT** |

### Action

Press a **LONG CLOSE.**

### Display

| |
|---|
| **INPANEL W/ START or<br>NEXT Menu W/ LONG CANCEL** |

### Action

To repeat the test, press **START**, otherwise press a **LONG CANCEL** for the next menu.

### Corrective Action

- Check connections.
- If any switch is not operating correctly, the entire membrane panel must be replaced.

## *Lamps Test*

This test steps through checking the various display panel lights. The corrective action is the same for any light malfunction and is presented at the end of the test.

### Display

| |
|---|
| **OUTPANEL W/ START. or<br>NEXT Menu W/ CANCEL** |

### Action

Press **START.**

### Display

| |
|---|
| **ON/OFF LIGHTS W/ START<br>NEXT LIGHT W/ CANCEL** |

### Action

- Press **START.**
- Verify both alarm lamps are on.
- Press **START** to turn light off.
- Press **CANCEL.**

**Display**

| ON/OFF LIGHTS W/ START<br>NEXT LIGHT W/ CANCEL |
|---|

**Action**

- Press **START.**
- Verify both vacuum lamps are on.
- Press **START** to turn light off.
- Press **CANCEL.**

**Display**

| ON/OFF LIGHTS W/ START<br>NEXT LIGHT W/ CANCEL |
|---|

**Action**

- Press **START**. Verify both injection lamps are on.
- Press **START** to turn light off.
- Press **CANCEL** for next light test.

**Display**

| ON/OFF LIGHTS W/ START<br>NEXT LIGHT W/ CANCEL |
|---|

**Action**

- Press **START**. Verify both diffusion lamps are on.
- Press **START** to turn light off.
- Press **CANCEL** for next light test.

**Display**

| ON/OFF LIGHTS W/ START<br>NEXT LIGHT W/ CANCEL |
|---|

### Action

- Press **START**. Verify both plasma lamps are on.
- Press **START** to turn light off.
- Press **CANCEL** for light test.

### Display

| |
|---|
| **ON/OFF LIGHTS W/ START**<br>**NEXT LIGHT W/ CANCEL** |

### Action

- Press **START**. Verify both vent lamps are on.
- Press **START** to turn light off.
- Press **CANCEL** for next screen test.

### Corrective Action

- Check bulbs and replace if necessary.
- Check control signal from CPU to control panel board.
- Check/replace control panel assembly.

## Sensor Tests

### Display

| |
|---|
| **SENSOR TEST W/ START**<br>**NEXT Menu W/ LONG CANCEL** |

### Action

- Press **START**.

## *Door Sensor Tests*

### Display

The door tests are normally run with the door open. Alternate displays are for tests with the door closed.

```
BLOCK DOOR TOP SENSOR
NEXT SENSOR W/ CANCEL
```

or with the door closed.

```
DOOR TOP SENSOR BLOCKED
NEXT SENSOR W/ CANCEL
```

### Action

- If the door top sensor is not blocked, use an object to block the door top sensor, or manually close the door. A beep occurs when the sensor is blocked.
- Press **CANCEL** for the next sensor test.

### Corrective Action

- If no beep, check the wiring and connections.
- Replace the sensor board.

### Display

```
DOOR BOTTOM BLOCKED
NEXT SENSOR W/ CANCEL
```

or with the door closed.

```
BLOCK DOOR BOTTOM
NEXT SENSOR W/ CANCEL
```

### Action

- If the door bottom sensor is not blocked, use an object to block the door bottom sensor. A beep occurs when the sensor is blocked.
- Since the door is usually open at this time, the sensor is blocked by the flag. Use the blue override button on the pneumatic solenoid to verify the sensor is working, by moving the door up.
- Press **CANCEL** for the next sensor test.

### Corrective Action

- If no beep, check the wiring and connections.
- Check the pneumatic board connector.
- Replace the sensor board.

| |
|---|
| **BLOCK DOOR CENTER<br>NEXT SENSOR W/ CANCEL** |

or with the door closed.

| |
|---|
| **DOOR CENTER BLOCKED<br>NEXT SENSOR W/ CANCEL** |

### Action

- Use the blue override button on the pneumatic solenoid to move the door to block the sensor. A beep occurs when the sensor is blocked.
- Press **CANCEL** for the next sensor test.

### Corrective Action

- If no beep, check the wiring and connections.
- Check the pneumatic board connector.
- Adjust the over center sensor flag.
- Replace the sensor board.

## *Cassette Sensor Tests*

### Display

| |
|---|
| **BLOCK CASSETTE SENSOR<br>NEXT SENSOR W/ CANCEL** |

### Action

- Use a cassette to block the cassette sensor. A beep occurs when sensor is blocked. Remove cassette.

### Display

| |
|---|
| **CASSETTE SENSOR BLOCKED<br>NEXT SENSOR W/ CANCEL** |

### Action

Press **CANCEL** for the next sensor test.

### Corrective Action

- Check the connections in the injector pump.
- Check the floating guides.
- Adjust the cassette optics.
- Replace injector pump.

### Display

Normal display

| |
|---|
| **TURN CHUTE SWITCH ON<br>NEXT SENSOR W/ CANCEL** |

or with chute switch pressed.

| |
|---|
| **CHUTE SWITCH ON<br>NEXT SENSOR W/ CANCEL** |

### Action

- Manually press down the chute switch. Beeps sound when the chute switch is closed. No beeps sound when the switch is opened.
- Press **CANCEL** for the next sensor test.

### Corrective Action

- If no beeps, check the wiring and connections.
- Replace switch.
- Replace the pneumatic board.
- Replace the digital I/O board.

Display with collection box removed.

| |
|---|
| **TURN BOX SWITCH ON<br>NEXT SENSOR W/ CANCEL** |

or with collection box in place.

| |
|---|
| **BOX SWITCH ON<br>NEXT SENSOR W/ CANCEL** |

### Action

- Place cassette box on box switch; the beeps should sound.
- Remove the cassette box from the box switch. No beeps should sound when the box is lifted.

### Action

- Press **CANCEL** for the next sensor test.

### Corrective Action

- If no beeps, check the wiring and connections.
- Replace switch.
- Replace the pneumatic board.
- Replace the digital I/O board.

## *Whitman Vacuum Switch Test*

***Note:*** *Not used with Block 2 systems.*

### Display

| |
|---|
| **TEST WHITMAN VAC SWITCH**<br>**W/ START OR NEXT W/ CANCEL** |

### Action

- Press **START**. Display indicates switch should be disconnected.
- Disconnect switch to test. Display indicates reconnection.
- Press **CANCEL.**

### Corrective Action

- Adjust the vacuum switch.

## *SMC Vacuum Switch Test*

***Note:*** *This test is for Block 2.0 systems only.*

### Display

| |
|---|
| **TEST SMC VAC SWITCH**<br>**W/ START OR NEXT W/ CANCEL** |

### Action

Press **START.**

### Display

| |
|---|
| **VACSW AT ATM. SET P1-P4=0**<br>**ON SMC EXIT W/ CANCEL** |

### Action

***Note:*** *If the SMC switch is set at any value other than P1=0, P2=0, P3=0, P4=0, the machine sounds a beep tone.*

- Use a fine pointed tool to press the vacuum switch SET button. The LCD displays P1=XX. Use the UP and DOWN keys to set P1=0.
- Press the SET button again and the LCD displays P2. Set P2=0 Repeat to set P3=0 and P4=0. Press SET. The red and green LEDs turn ON.

### Display

| |
|---|
| **SET P1&P3=70, P2&P4=0**<br>**ON SMC EXIT W/ CANCEL** |

### Action

***Note:*** *Ignore the above reading.*

- Use a fine pointed object to press the vacuum switch SET button. The LCD displays P1=XX. Use the UP and DOWN keys to set P1=70.
- Press the SET button again and the value of P2 is displayed. Set P2=15. Repeat the above procedure to set P3=70 and P4=15. When correctly reset, the beeps stop and the red and green LEDs turn OFF.

### Corrective Action

- Verify that the pneumatic is at the current revision and the connector jumper on the board is at HI AT ATM. (If the board does not have a part number, or is not the current revision, this step does not apply.)
- Press RESET on the vacuum switch for 2 seconds.
- Replace the vacuum switch.
- Replace the wiring.

**Display**

| |
|---|
| EXIT SENSOR TEST<br>W/ LONG CLOSE |

**Action**

Press a **LONG CLOSE.**

**Display**

| |
|---|
| SENSOR TEST W/ START or<br>NEXT Menu W/ LONG CANCEL |

**Action**

To repeat test press **START**, otherwise press a **LONG CANCEL.**

# Injection and Pneumatics Tests

**Display**

| |
|---|
| INJPNEU W/ START<br>NEXT Menu W/ LONG CANCEL |

**Action**

✦ Press START.

## *Pawl Test*

**Display**

| |
|---|
| ON/OFF PAWL W/ START<br>NEXT OUTPUT W/ CANCEL |

**Action**

✦ Press **START**. Verify that the pawl has lifted.

✦ Insert a cassette and verify that the pawl clears the cassette by 0.2 mm minimum (.008). Remove the cassette.

### Corrective Action

- Adjust pawl assembly by loosening the screws holding the solenoid and lift it up to the maximum height. Retighten screws.
- Check voltage at J102, should be 12 VDC.
- Replace the injector pump.

### Display

```
RELEASE PAWL W/ START
NEXT OUTPUT W/ CANCEL
```

### Action

- Press **START**. Verify that pawl has dropped under its own weight and engages cassette.
- Press down lightly on seal base and verify that 0.2 mm minimum clearance exists between the seal base O-ring and the top of a cassette.

### Corrective Action

If clearance is not correct, replace injector pump.

### Display

```
LIFT PAWL W/ START
NEXT OUTPUT W/ CANCEL
```

### Action

- Press **CANCEL**.
- Remove cassette.

## *Motor Test*

### Display

```
ON/OFF MOTOR IN W/ START
NEXT OUTPUT W/ CANCEL
```

### Action

- Observe the cassette as it travels through the pump.
- Observe floating guide gap. It should be within specifications.
- Press **START.**

### Display

STOP MOTOR W/ START.

or

NEXT OUTPUT W/ CANCEL

### Action

Press **START** or **CANCEL.**

### Display

MOTOR IN W/ START
NEXT OUTPUT W/ CANCEL

### Action

Press **START** or **CANCEL.**

### Display

ON/OFF MOTOR OUT W/ START
NEXT OUTPUT W/ CANCEL

### Action

- The cassette travels backward through the injector pump and the cassette door swings open.
- Press **START** or **CANCEL.**

### Display

STOP MOTOR W/ START
NEXT OUTPUT W/ CANCEL

### Action

Press **CANCEL.**

**Display**

| MOTOR OUT W/ START<br>NEXT OUTPUT W/ CANCEL |
|---|

**Action**

✦ Press **START** or **CANCEL.**

## *Injection Test*

**Display**

| ON/OFF INJECT W/ START<br>NEXT OUTPUT W/ CANCEL |
|---|

**Action**

**WARNING! Exposure to H2O2! DO NOT use a cassette with ANY full cells for the following test.**

**Verify injection**

✦ Insert a used, empty cassette into the injector pump and verify that it glides easily between the guides without pinching (0.5 mm). ·

✦ Ensure that the pawl is fully engaged in the cassette.

✦ Press **START** to extend the cam and verify that the roller sits on the flat of the cam when fully extended.

✦ Press **START** to retract cam. When the cam is retracted, remove the cassette.

## *Verify Valve Height*

***Note**: Block 2 procedures are shown below.*

1. Press START to fully extend the cam and insert the injector cassette gap tool from the back of the platen.
2. Push the platen down to allow the tool to advance on top of injector valve.
3. Verify that seal block o-ring and needle seals clear the opening in the cassette gap tool.
4. Turn the injector valve mounting screws to raise the valve until no gap exists between seal block and tool or between the needle seal retainer plate and tool.
5. Remove the cassette gap tool.

## *Verify Valve Height for Block 2 systems.*

***Note**: With the front panel removed, this procedure can be performed from the front of the unit.*

1. Extend the cam.
2. Insert the gap tool from the front.
3. If adjustment is required, loosen the set screw locking the sealing ring. Turn the knurled ring until the tool has a snug fit. Tighten the set screw.
4. Remove the cassette gap tool.

### Corrective Action

- ✦ Adjust the injector valve height
- ✦ If cam does not extend properly, check the injector solenoid and replace if necessary.
- ✦ Replace the injector pump.

## *Vaporizer Heater Test*

### Display

**ON/OFF VAPORIZER HEATER**
**W/ START OR NEXT W/ CANCEL**

### Action

- ✦ Press **START**
- ✦ A beep sounds to verify that the current sensor is functioning.
- ✦ Check voltage at injector valve connector P-46, the voltage should be 20 -24 VAC (loaded).

### Corrective Action

- ✦ Replace wire harness.
- ✦ Replace solid state relay board.
- ✦ Replace current sensor if no beep tone sounds.
- ✦ Verify correct heater impedance.
- ✦ Replace injector valve.
- ✦ Check connection at injector pump.

### Display

| VAPORIZER OFF W/ START<br>NEXT OUTPUT W/ CANCEL |
|---|

### Action

- Press **START**.
- Check voltage at injector valve connector P-46, should be VAC. beep warning should stop.

### Corrective Action

If 5 VAC, or beep sound persists, replace solid state relay board.

### Display

| VAPORIZER ON W/ START<br>NEXT OUT PUT W/ CANCEL |
|---|

### Action

Press **CANCEL.**

## *Chamber Door Test*

### Display

| OPEN/CLOSE CHAMBER DOOR<br>W/ START OR NEXT W/ CANCEL |
|---|

### Action

- Press **START**.
- Verify that door sensors are secured and are not subject to damage during operation. Verify flags are centered in sensors.
- Adjust the speed control valve on door cylinder.

- **Block 2**. Verify chamber door closes in approximately 5 seconds, adjust and secure speed control valves on pneumatic control assembly.
- Verify that the door is sealed.
- Verify that door meets chamber door stop.
- Check that door actuator arms are extended but not over center.
- Check that guide cables are tensioned.

- Check that door is aligned horizontally.

### Corrective Action

- Make adjustments to stops and guide cables as necessary.
- Replace door solenoid
- Replace pneumatics board.

### Display

**OPEN CHAMBER DOOR**
**W/ START OR NEXT W/ CANCEL**

### Action

- Press **START**.
- Verify that chamber door opens.
- Adjust speed control valve on door cylinder.

- Adjust and secure speed control valves on pneumatic control assembly, so that door opens smoothly in approximately 5 seconds.

### Corrective Action

- Make adjustments to stops and guide cables as necessary.
- Replace door solenoid
- Replace pneumatics board.

### Display

**CLOSE CHAMBER DOOR**
**W/ START OR NEXT W/ CANCEL**

### Action

Press **CANCEL.**

## *Cassette Door Test*

### Display

**OPEN/CLOSE CASSETTE DOOR**
**W/ START OR NEXT W/ CANCEL**

### Action

- Press **START**.
- Verify cassette door opens smoothly, or, if front panel is not present.
- Verify that voltage at P43 is +12, ±1 VDC (ON).

### Corrective Action

- Replace cassette door assembly.
- Replace wire harness.
- Replace injector pump board.

### Display

**CLOSE CASSETTE DOOR**
**W/ START OR NEXT W/ CANCEL**

### Action

- Press **START**.
- Verify cassette door closes completely.
- Check that voltage at P43 is 0 VDC.

### Corrective Action

Replace injector pump board.

### Display

**OPEN CASSETTE DOOR**
**W/ START OR NEXT W/ CANCEL**

### Action

Press **CANCEL.**

**Display**

| |
|---|
| **EXIT INJPNEU WITH LONG CLOSE** |

**Action**

Press a **LONG CLOSE.**

**Display**

| |
|---|
| **INJPNEU W/ START or NEXT Menu W/ LONG CANCEL** |

**Action**

To repeat test press START, otherwise press **LONG CANCEL.**

# Throttle Valve/Heater Menus

**Display**

| |
|---|
| **THROTTLE/HEATER W/ START NEXT Menu W/ LONG CANCEL** |

**Action**

Press **START.**

## *Winding Tests*

**Display**

***Note**: Winding tests are normally not performed. They are presented here for information only.*

| |
|---|
| **ON/OFF WINDING W/ START NEXT OUTPUT W/ CANCEL** |

**Action**

Press **CANCEL** for next output.

### Display

| |
|---|
| WINDING ON W/ START<br>NEXT OUTPUT W/ CANCEL |

### Action

Press **CANCEL** for next output.

### Display

| |
|---|
| WINDING OFF W/ START<br>NEXT OUTPUT W/ CANCEL |

### Action

Press **CANCEL** for next output.

## *Stepper Tests*

### Display

| |
|---|
| ON/OFF STEPPER W/ START<br>NEXT OUTPUT W/ CANCEL |

### Action

- Press **START**.
- Verify that throttle valve is cycling smoothly.
- LED on throttle valve controller board is green in the open position, and red in the closed position.
- Press **START** to stop cycling.
- Press **CANCEL.**

### Corrective Action

Replace throttle valve assembly.

## *Chamber/Door Heaters Test*

### Display

| ON/OFF HEATER<br>W/ START OR NEXT W/ CANCEL |
|---|

### Action

Press **START.**

### Display

| HEAT ON W/ START<br>NEXT OUTPUT W/ CANCEL |
|---|

### Action

- Press **START.**

- Check that voltage at chamber heater connectors (1 chamber connector on Block 2) reads 115 or 230 VAC depending on system type. (208 VAC for Block 2.)

- Check that voltage at door heater connectors P95 reads 115 or 200 VAC depending on system type. (208 VAC for Block 2.) These are nominal readings only to check shorts and opens. (There is only one connector on Block 2.)

### Corrective Action

- Replace thermistors.
- Replace solid state relay board.
- Verify impedance of heaters.

***Note:*** *If temperature error is shown on the display, press OPEN to recover. Repeat the test.*

### Display

| HEAT OFF W/ START AXXX.XV<br>NEXT OUTPUT W/ CANCEL |
|---|

### Action

- Press **START**.

- Verify voltage at P115 in the chamber reads 1 VAC. There is only one connector on Block 2.)·

✦ Also, verify voltage at P95 in the door reads 1 VAC.

### Corrective Action

Replace solid state relay board.

### Display

| |
|---|
| **HEAT ON W/ START**<br>**NEXT OUTPUT W/ CANCEL** |

### Action

Press **CANCEL** for next output.

## *Oil Return Valve Tests*

### Display

***Note:*** *The following test is for Block 2 and all STERRAD 100 S machines. On Block 2 there is a 120 VAC on the connector. On Block 1.8 (with STERRAD 100 S software) there is a 12 VDC connector.*

| |
|---|
| **ON/OFF OIL SW W/ START**<br>**NEXT OUTPUT W/ CANCEL** |

### Action

Press **START.**

### Display

| |
|---|
| **OIL SWITCH ON W/ START**<br>**NEXT OUTPUT W/ CANCEL** |

### Action

Verify the oil switch is on by measuring the voltage connector on the oil return valve or, listen to hear the solenoid click

### Corrective Action

✦ Check wiring.

✦ Replace solid state relay board.

✦ Replace digital I/O board.

✦ Replace switch.

**Display**

| OIL SWITCH OFF W/ START<br>NEXT OUTPUT W/ CANCEL |
|---|

**Action**

- Press **START**.
- Verify the oil switch is OFF by measuring the voltage on the oil connector.

**Corrective Action**

- Check wiring.
- Replace solid state relay board.
- Replace digital I/O board.

**Display**

| OIL SWITCH ON W/ START<br>NEXT OUTPUT W/ CANCEL |
|---|

**Action**

- Press **CANCEL**.
- Press **LONG CANCEL** to bypass the next tests.

## *Cassette Switch Tests*

***Note:*** *The following tests are not applicable for the field. They are for units with cassette feeders. The displays are shown for information only.*

**Display**

| ON/OFF CASSETTE SWITCH<br>W/ START OR NEXT W/ CANCEL |
|---|

***Note:*** *This signal can only be measured if the machine is equipped with the harness or tool for the cassette feeder or if the machine is a Block 2 system.*

**Display**

| CASSETTE SW ON W/ START<br>NEXT OUTPUT W/ CANCEL |
|---|

**Display**

CASSETTE SW OFF W/ START
NEXT OUTPUT W/ CANCEL

**Display**

CASSETTE SW ON W/ START
NEXT OUTPUT W/ CANCEL

**Display**

EXIT THROTTLE/HEATER
WITH LONG CLOSE

**Display**

THROTTLE/HEATER W/ START
NEXT Menu W/ LONG CANCEL

**Display**

EXIT THROTTLE/HEATER TEST
W/ LONG CLOSE

# Door Test

**Display**

DOORTST W/ START or
NEXT Menu W/ LONG CANCEL

**Action**

Press **START.**

**Display**

CLOSE THE DOOR W/ START or
EXIT DOORTST, LONG CLOSE

**Action**

✦ With the door open, place a protective block on the door shelf to protect from scratches and press **START**.

- When the door is closing the LCD displays.

| DOOR IS CLOSING<br>TEST CENTER, BLOCKED DOOR |
|---|

- While the door is closing, press down on the protective block to verify retracting.

### Corrective Action

- Check the 12 V power supply.
- Adjust or replace the door over-center sensor.
- Replace the door solenoid.

### Display

| CLOSE THE DOOR W/ START or<br>EXIT DOORTST, LONG CLOSE |
|---|

### Action

Press **START**.

When the door is closing the LCD displays:

| DOOR IS CLOSING<br>TEST CENTER, BLOCKED DOOR |
|---|

When the door is closed the LCD displays:

| TOP AND CENTER BLOCKED<br>OPEN WITH START |
|---|

### Action

- Press **START**.
- When the door opens the LCD displays:

| CHECK BOTTOM SENSOR<br>IS NOT BLOCKED |
|---|

Verify that the bottom sensor is not blocked.

### Corrective Action

Adjust flag or replace bottom sensor.

**Display**

```
CLOSE THE DOOR W/ START or
EXIT DOORTST, LONG CLOSE
```

**Action**

Press a **LONG CLOSE.**

**Display**

```
DOORTST W/ START  or
NEXT Menu W/ LONG CANCEL
```

**Action**

To restart test press **START**, otherwise press a **LONG CANCEL.**

# Analog Test

**Display**

```
ANALOG W/ START
NEXT Menu W/ CANCEL
```

**Action**

Press **START.**

**Display**

```
CHAN #0 CHAMBER PRESSURE
CONTINUE W/ START
```

**Action**

Press **START.**

**Display**

```
4.095 V. PRESSURE INPUT
NEXT INPUT W/ CANCEL
```

**Action**

✦ Initial reading is a reference reading.

- Remove connector from capacitance manometer (Baratron) pressure sensor and attach the adjustment tool to the connector.
- Adjust trimpot on tool so that value in LED is approximately 4.000 V. (or similar number that is easily divided by 2.)·
- Press **CANCEL.**

### Corrective Action

- If no reading, or reading is not steady, check wiring for noise or bad connection.

***Note**: Channels 1-6 are not tested at this time. Press CANCEL to skip.*

### Display

**CHAN #1 RF REFLECT POWER**
**CONTINUE W/ START**

### Display

**0.587 V., REFLECT POWER**
**NEXT INPUT W/ CANCEL**

### Display

**CHAN #2 RF DEL. POWER**
**CONTINUE W/ START**

### Display

**0.589 V., DEL. POWER**
**NEXT INPUT W/ CANCEL**

### Display

**CHAN #3 FLOATING INPUT**
**CONTINUE W/ START**

### Action

Press **START.**

### Display

**4.095V., FLOATING POINT**
**NEXT INPUT W/ CANCEL**

### Action

- Value may vary.
- Press **CANCEL.**

### Display

```
CHAN #4 FLOATING INPUT
CONTINUE W/ START
```

### Action

Press **START.**

### Display

```
4.095V., FLOATING POINT
NEXT INPUT W/ CANCEL
```

### Action

Press **CANCEL.**

This channel is currently unused.

### Display

```
CHAN #5 DOOR TEMPERATURE
CONTINUE W/ START
```

### Display

```
#.### V. DOOR TEMP.
NEXT INPUT W/ CANCEL
```

### Display

```
CHAN #6 CHAMBER TEMP
CONTINUE W/ START
```

### Display

```
#.### V. CHAMBER TEMP.
NEXT INPUT W/ CANCEL
```

### Display

| |
|---|
| CHAN #7 HIGH PRESS CHNL<br>CONTINUE W/ START |

### Display

| |
|---|
| #.### V. HIGH PRESSURE<br>NEXT INPUT W/ CANCEL |

### Action

- This pressure reading should be exactly half the channel 0 reading. If not, adjust pot R7 (Block 2 is R5) on the connector distribution board until the LCD reads exactly half the channel 0 reading.

- Apply a small amount of Glyptal to R7 (Block 2 is R5) to lock in place after adjustment is competed.
- Remove adjustment tool from pressure sensor connector and re-connect the harness to Baratron pressure sensor.
- Press **CANCEL.**

### Corrective Action

- Verify that the adjustment tool's impedance is correct.
- Replace the control enclosure if the adjustments cannot be made.

### Display

| |
|---|
| EXIT ANALOG INPUT<br>WITH LONG CLOSE |

### Action

Press a **LONG CLOSE.**

### Display

| |
|---|
| ANALOG W/ START<br>NEXT Menu W/ LONG CANCEL |

### Action

- To restart test, press START, otherwise press a **LONG CANCEL.**

# Vacuum Subsystem Tests

### Display

| |
|---|
| VAC_RF W/ START<br>NEXT Menu W/ LONG CANCEL |

### Action

- Press **START**.

## *Pump Rotation Tests*

### Display

| |
|---|
| CHECK PUMP ROTATION<br>W/ START or NEXT W/CANCEL |

### Action

- Press **START**.
- Verify that air is flowing out of the exhaust port. The motor rotates for 10 seconds.

### Corrective Action

- Check the hospital wiring for correct (CBA) phase rotation.
- Press motor starter override to start pump.
- Check the wiring.
- Replace the solid state relay board.
- Replace the motor starter.

### Display

| |
|---|
| PUMP IS ON<br>NEXT W/ LONG CANCEL |

### Action

Press a **LONG CANCEL.**

## *Vacuum-RF Test*

### Display

DOOR CLOSE/OPEN W/ START
NEXT W/ LONG CANCEL

### Action

Press **START.**

### Display

CLOSE DOOR W/ START
NEXT W/ LONG CANCEL

### Action

- Press **START**.
- Verify operation of door.
- Verify that chamber O-ring is seated against door face.

### Corrective Action

Realign door.

### Display

DOOR CLOSE, NEXT VENT
NEXT W/ LONG CANCEL

### Action

Press a **LONG CANCEL.**

### Display

CLOSE VENT W/ START

### Action

- Press **START**.
- Verify vent is closed.

### Corrective Action

- Replace solid state relay board.
- Replace vent valve.

### Display

| |
|---|
| VENT CLOSE, PUMP'S NEXT<br>NEXT W/ LONG CANCEL |

### Action

Press a **LONG CANCEL.**

### Display

| |
|---|
| PUMP ON/OFF W/ START<br>NEXT W/ LONG CANCEL |

### Action

Verify that throttle valve is in open position, indicated by a green LED on the throttle valve board, and press START.

### Display

| |
|---|
| PRESS 15 TORR, WAIT 600mT<br>NEXT W/ LONG CANCEL |

### Action

- As vacuum reaches 600 mTorr, observe the LED on the throttle valve. When the pressure reaches 525 mTorr, the throttle valve should close. (Indicated by a red LED on the throttle valve board.)·
- After the throttle valve is closed, manually inject H2O2 by pressing and holding the blue button (Block 2) on the front solenoid valve at the pneumatic control assembly or the orange button (Block 1.8) on the right solenoid valve.
- Observe the pressure reading on the control panel, it should increase rapidly. Release the button when the pressure reading stops increasing.
- After 500 mTorr is reached and is stable, press a LONG CANCEL for the next menu.

### Corrective Action

- Check throttle valve harness connections
- Replace throttle valve.
- Perform a Leak Back Test.

## *RF Test Set-Up and Test*

### RF Test Set-Up

**WARNING:- RF power is present during this operation. do not touch the RF generator or any of the wiring.**

- If peroxide has been injected, run the RF for 15 minutes. Monitor the reflected power display in mV. The value begins as high as 500 mV then is decreases to a value typically below 100 mV. If the value begins to climb above 300 mV, there is a potential mismatch in impedance.
- After 500 mTorr is reached and is stable, press a **LONG CANCEL** for the RF Test menu.
- Set-up a Bird Watt meter on the X10 scale. Reading is on the Kilowatt scale.
- Connect the RF generator to the INPUT of the directional coupler on the Watt.
- Connect the RF interconnect cable to the OUTPUT of the directional coupler Watt. The RF element arrow should point towards the RF match.

### RF Test

### Display

| |
|---|
| **P= 500 mT,**<br>**TURN RF ON W/ START** |

### Action

- Press **START**.
- Verify operation of RF by observing RF power measurement using the Bird Watt meter. Observe for 15 minutes.
- Clean the electrode, RF feedthrough and chamber using deionized water and a Scotch Brite-type scrub pad.

### Display

```
PRESS= XXX, FWD= XXX
RFL= XXX, OFF W/ START
```

### Action

- Allow pressure to stabilize, observe pressure and RF forward voltage reading on control panel LCD display. ·
- Verify that pressure is stable every 5 minutes for 15 minutes. Note RF power reading
- RF delivered (from LCD read-out) - 3000 mVDC minimum.
- RF reflective is less than 300 mVDC.
- RF power forward from power meter - .360 kW, .440 kW.
- After running plasma for 15 minutes, press START and verify the RF generator is off by verifying that the Watt meter reads 0.·
- Turn off the Watt meter and disconnect it from the RF generator.
- Remove the RF interconnect cable from the power meter and reconnect it to RF generator.
- Press **START** to verify voltages are correctly displayed and to verify that plasma is ON.
- Press a **LONG CANCEL** from this menu to perform a leak test.

### Corrective Action

- Check the connections at the RF match, cable and electrode.
- Check the electrode screws and match screws are correctly seated.
- Replace the electrode if necessary.
- Replace the RF delivery system if plasma is not induced or RF power failure.

## *Leak Back Test*

### Display

```
LEAKTEST W/ START
NEXT W/ LONG CANCEL
```

### Action

Press **START** once.

### Display

```
P0=XXX mTorr P=XXX mTorr
WAIT 5 MINUTES
```

Wait 5 minutes. After 5 minutes the display shows:

```
XXX  mT  P5=XXX mt
L/M = XX mT, W/ CANCEL
```

### Action

- Definition,

  mTorr is a real-time reading of internal chamber pressure.

  P0= starting pressure.

  mT P5= pressure after five minutes.

  L/M = leak rate per minute. Leak rate should be no more than 125 mTorr per 5 minutes. (25 mTorr per minute).

- Wait 5 minutes.
- Press **LONG CANCEL.**

### Corrective Action

Locate and repair (when practical) chamber leak if leak rate is in excess of 125 mTorr/5 minutes. If a repair cannot be made, it may be necessary to replace one or more of the system assemblies.

### Display

```
EXIT VAC-RF W/ START
NEXT W/ LONG CANCEL
```

### Action

Press START.

### Display

```
DOOR WILL OPEN AT 730 T
NEXT W/ LONG CANCEL
```

### Action

- Verify opening of throttle valve.
- Verify opening of vent valve.
- Verify smooth opening of door at atmosphere.
- Press **LONG CANCEL.**

### Corrective Action

- Replace vent valve assembly.
- Adjust vacuum switch if door does not open smoothly.

### Display

**VAC_RF W/ START or**
**NEXT W/ LONG CANCEL**

### Action

- Allow machine to cool down for 5 minutes with door open.
- Press **START** and repeat the leak test without running plasma. Record the final leak rate.
- Press **CANCEL** and then **START** to exit the test

### Corrective Action

Locate and repair (when practical) chamber leak if leak rate is 125 mTorr/5:00 minutes. If a repair cannot be made, it may be necessary to replace one or more of the system assemblies.

# Cassette Adjustments

### Display

**CASSETTE ADJ W/ START or**
**NEXT Menu W/ LONG CANCEL**

### Action

Press **START.**

**Display**

| INSERT CASSETTE |
|---|

**Action**

Insert a cassette into the injector pump and adjust the trimpot on the fiber optic amplifier until the cassette is accepted and cycles back and forth.

**SAMPLE Display**

| BC minW = XX minB = XX<br>SL AVR = XXX minB = XX |
|---|

Press **OPEN** to change display for fiber optic amplifier calibration.

**SAMPLE Display**

| MINWL = XX MINWH= XX<br>MID PT = XX MINW = XX |
|---|

***Note:*** *It is important that the values used for calculating the mid point by the software are the last minWH and minWL where the cassette continued to cycle, as these values are put into a register to calculate mid pt. If the cassette fails to cycle after either of these values are reached, the calibration must be repeated.*

## *Cassette Optics Adjustment.*

- While the cassette continues to cycle in and out, adjust trim pot R1 on the injector pump PCB for an AVR of 500 ±5 (clockwise to increase, counterclockwise to decrease).·
- Press **OPEN DOOR**. While the cassette continues to cycle in and out, adjust the fiber optic amplifier trim pot (on the bottom fiber optic amplifier) counterclockwise in 1/4 turn increments until the cassette no longer cycles and is ejected to the front or back of the injector pump. Note the BC minWL number displayed on the LCD at the point where the cassette discontinues cycling. ·
- Adjust the fiber optic amplifier trim pot clockwise one turn and reinsert the cassette.

  ***Note:*** *The cassette should continue to cycle in and out. If it does not, continue to adjust the side slot trim pot one turn clockwise until the injector pump accepts the cassette.*

- While the cassette continues to cycle in and out, adjust the fiber optic amplifier trim pot clockwise in 1/4 turn increments until the cassette no longer cycles and is ejected to the front of the injector pump. Note the BC minWH number displayed on the LCD.

- The software calculates the midpoint of the minW numbers obtained in the previous steps.
- Adjust the fiber optic amplifier trim pot counterclockwise 1 turn and reinsert the cassette.

  ***Note:*** *The cassette should continue to cycle in and out. If it does not, continue to adjust the side slot trim pot 1/4 turn COUNTER-CLOCKWISE until the injector pump accepts the cassette.*

- While the cassette continues to cycle in and out, adjust fiber optic amplifier trim pot to obtain the midpoint minW number calculated in the previous step.
- Re-verify that the speed (SL AVR) is still 500 ±5 at this setting. Ignore the values for BC minB and SL minB.
- Press **START**. The system runs a 10 cycle verification.

### Corrective Action

- If adjustments cannot be achieved, replace injector pump board.
- Exit by pulling cassette out of injector pump from the front or the rear, whichever is easier.

### Display

**INSERT NEW CASSETTE**

### Action

Press a **LONG CLOSE.**

### Display

**CASSETTE ADJ W/ START or**
**NEXT Menu W/ LONG CANCEL**

### Action

Press a **LONG CANCEL.**

***Note:*** *The following test is not performed at this time.*

### Display

**SLOT ADJ. W/ START**
**NEXT Menu W/ LONG CANCEL**

### Action

✦ Press a **LONG CANCEL.**

# Printer Test

### Display

| PRINTER W/ START or<br>NEXT Menu W/ LONG CANCEL |
|---|

If not already done, route printer paper through printer.

### Action

Press **START.**

***Note:*** *Block 2 systems only print black characters. Other systems print black and red.*

### Corrective Action

✦ Check printer cables.

✦ Replace ribbon.

✦ Replace printer.

### Display

| RESTART W/ START<br>EXIT W/ LONG CLOSE |
|---|

### Action

To go to beginning of main menu, press a **LONG CLOSE**.

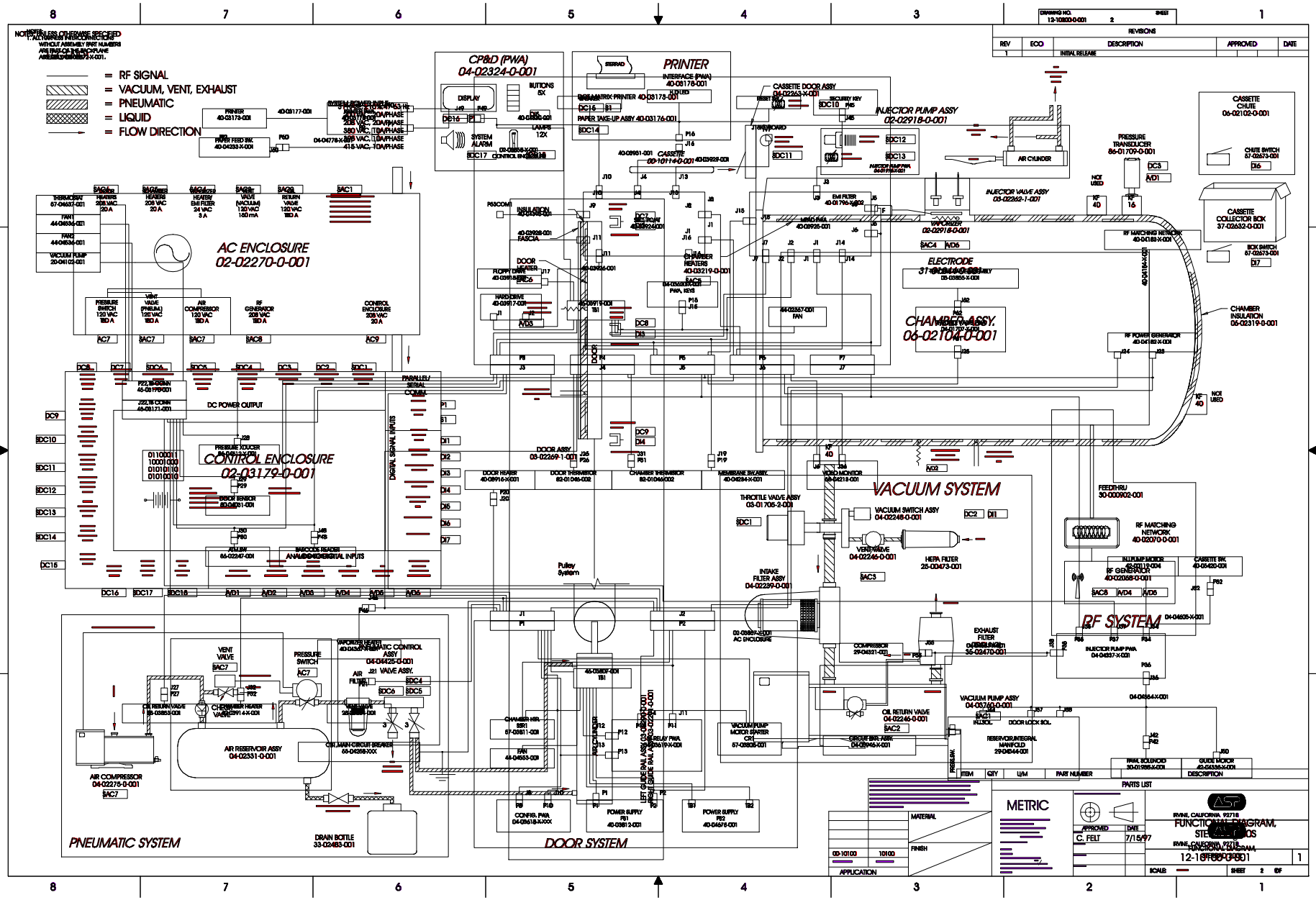
# STERRAD® 100 Schematics

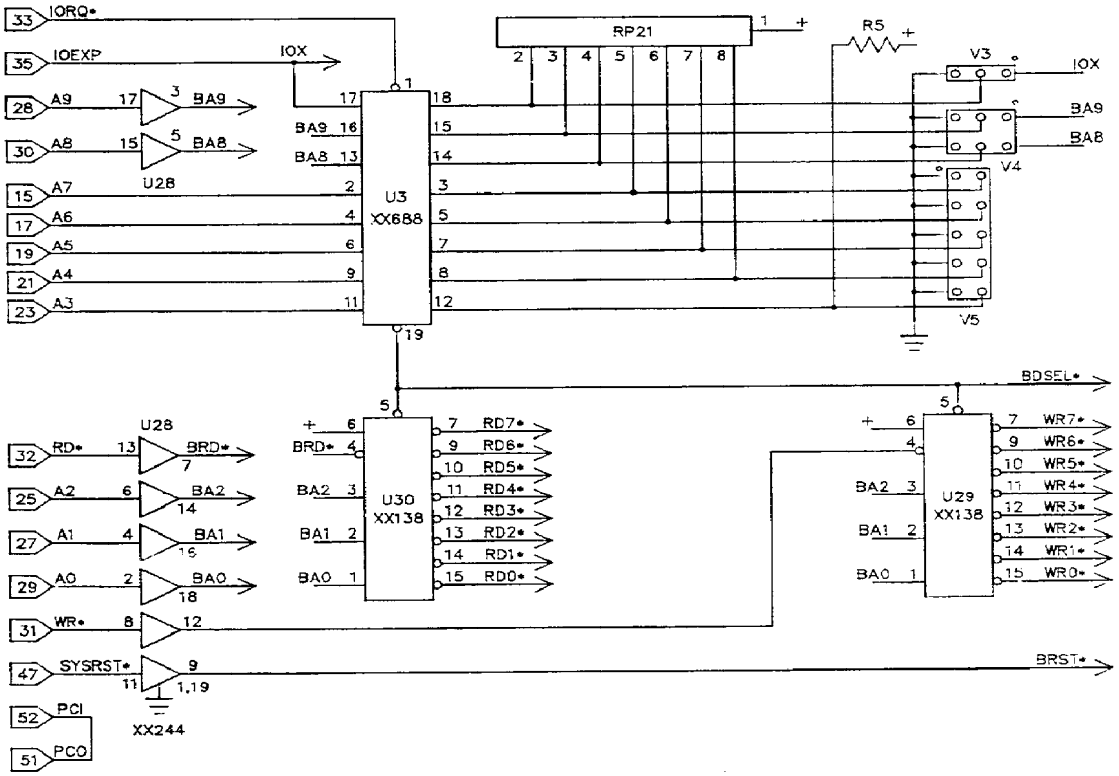
The schematics listed below pertain to both Block 1.8 and **Block 2** unless otherwise stated. If there is more than one schematic, both are shown. Click on the schematic name to jump to that schematic. Or, click on the third button from the left on the tool bar above. This gives you a "thumbnail" view of the schematics. Click on the thumbnail to jump to the schematic you want. Use the arrows shown on the tool bar above to move back and forth through the document.

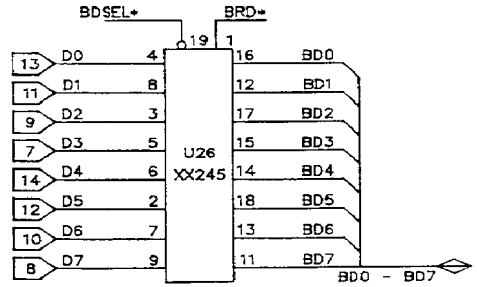
*Note: If you are printing the schematics, set your printer to landscape mode for the best printing.*

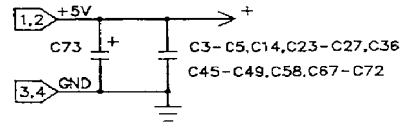

- **Functional Diagram**
- **Cable interconnect diagram 10-01810-1-100-A Block 1.8**
- **Cable interconnect diagram 10-03252-0-100-A Block 2.**
- **Digital I/O Board VL-7508 Rev O Drawing 1**
- **Digital I/O Board VL-7508 Rev O Drawing 2**
- **Digital I/O Board VL-7508 Rev O Drawing 3**
- **Pneumatic flow schematic 10-00189-1-100 D**
- **Pneumatic PWB schematic 10-00916-2-100**
- **Pneumatic PWB schematic 10-04652-1-100**
- **Pneumatic PWB schematic 10-6475-0-100 (STERRAD® 100 SI GMP only)**
- **Control panel PCB 10-00952-100-F Block 1.8**
- **Control panel PCB 10-02324-0-100-C Block 2**
- **Solid state relay PCB 10-00974-100-E Block 1.8**
- **Solid state relay PCB 10-02143-0-100-C Block 2**
- **Board sensor schematic 10-00975-100-G**

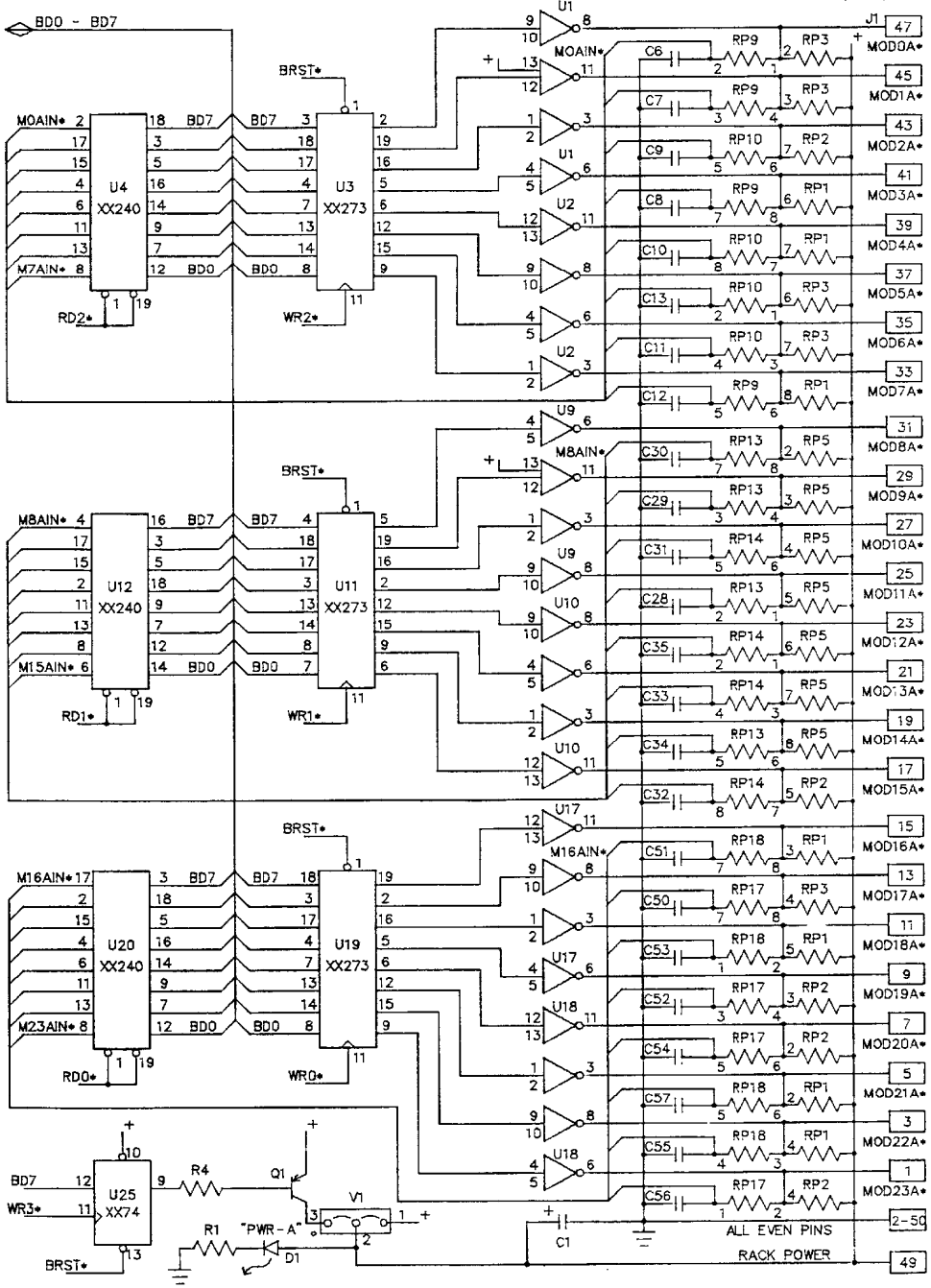
- **Stepper motor driver PCB 10-01090-100-F**
- **Throttle valve PCB 10-01707-0-100-B**
- **Connector distribution 10-01766-2-100-B Block 2**
- **Configuration PCB 208 VAC 10-02195-0-101 Block 2**
- **Configuration PCB 380 VAC 10-02195-0-102 Block 2**
- **Configuration PCB 398 VAC 10-02195-0-103 Block 2**
- **Configuration PCB 415 VAC 10-02195-0-104 Block 2**
- **Configuration PCB 200 VAC 10-02195-0-106 Block 2**
- **Injector pump PCB 10-01918-1-100-C**
- **AC distribution elementary diagram 10-01988-0-XX-E Block 1.8**
- **AC distribution elementary diagram 10-02270-0-100-C Block 2**

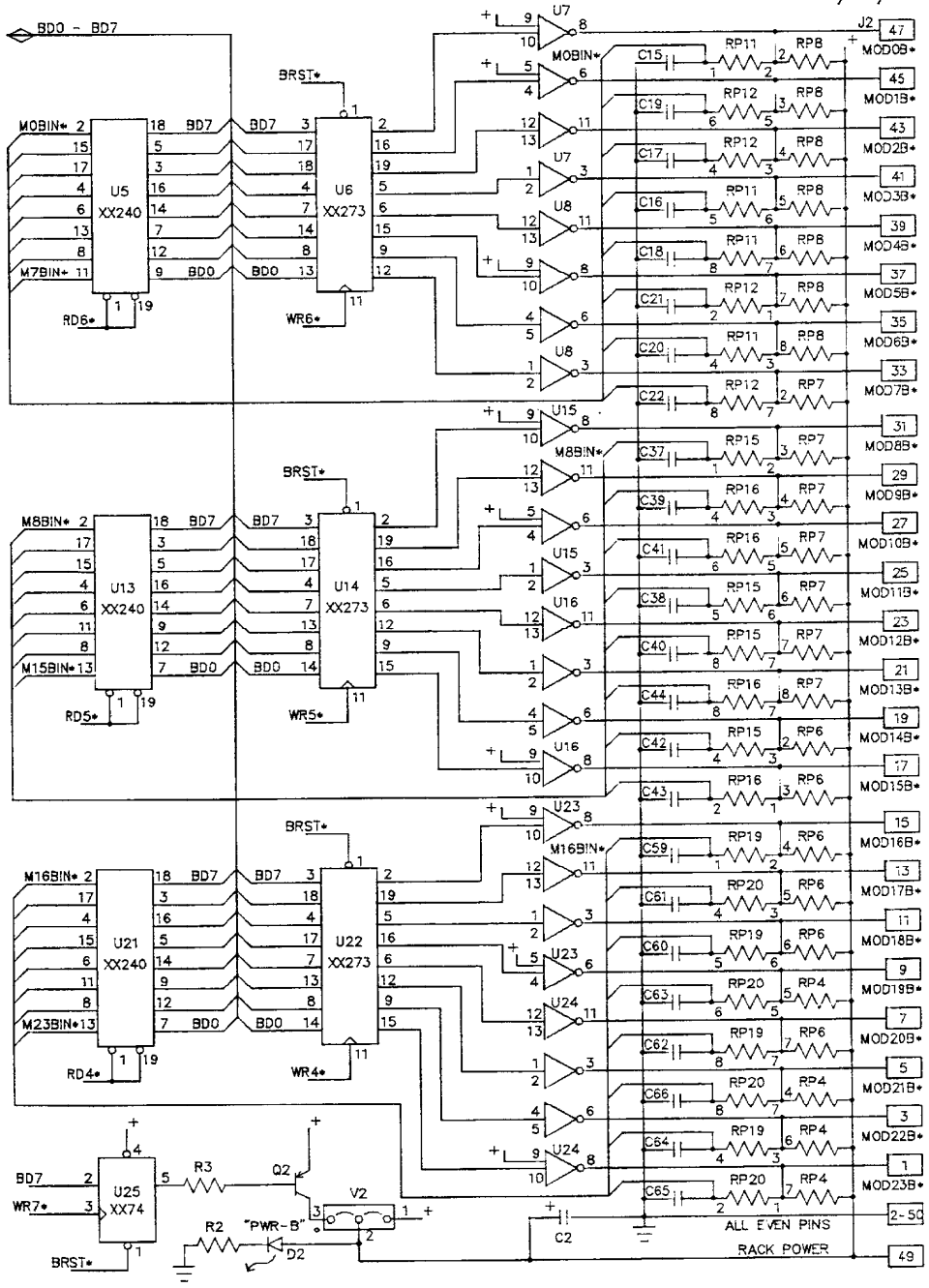

= RF SIGNAL
= VACUUM, VENT, EXHAUST
= PNEUMATIC
= LIQUID
= FLOW DIRECTION
CP&D (PWA)
04-02324-0-001
PRINTER
AC ENCLOSURE
02-02270-0-001
CONTROL ENCLOSURE
02-03179-0-001
CHAMBER ASSY.
06-02104-0-001
INJECTOR PUMP ASSY
02-02918-0-001
VACUUM SYSTEM
RF SYSTEM
PNEUMATIC SYSTEM
DOOR SYSTEM
AIR COMPRESSOR
04-02275-0-001
AIR RESERVOIR ASSY
04-02331-0-001
DRAIN BOTTLE
33-02483-001
DC POWER OUTPUT
PARALLEL/ SERIAL COMM.
DIGITAL SIGNAL INPUTS
ELECTRODE
CASSETTE CHUTE
06-02102-0-001
CASSETTE COLLECTOR BOX
57-02632-0-001
CHAMBER INSULATION
06-02319-0-001
RF MATCHING NETWORK
40-02070-0-001
RF GENERATOR
40-02068-0-001
VACUUM PUMP ASSY
04-03760-0-001
PARTS LIST
METRIC
FUNCTIONAL DIAGRAM, STEPPER
FUNCTIONAL DIAGRAM
12-10800-0-001


33 IORQ*
35 IOEXP
IOX
28 A9
30 A8
U28
15 A7
17 A6
19 A5
21 A4
23 A3
U3
XX688
RP21
R5
V3
V4
V5
IOX
BA9
BA8
BDSEL*
U28
32 RD*
25 A2
27 A1
29 A0
31 WR*
47 SYSRST*
52 PCI
51 PCO
XX244
U30
XX138
RD7*
RD6*
RD5*
RD4*
RD3*
RD2*
RD1*
RD0*
U29
XX138
WR7*
WR6*
WR5*
WR4*
WR3*
WR2*
WR1*
WR0*
BRST*


BDSEL*
BRD*
13 D0
11 D1
9 D2
7 D3
14 D4
12 D5
10 D6
8 D7
U26
XX245
BD0
BD1
BD2
BD3
BD4
BD5
BD6
BD7
BD0 - BD7

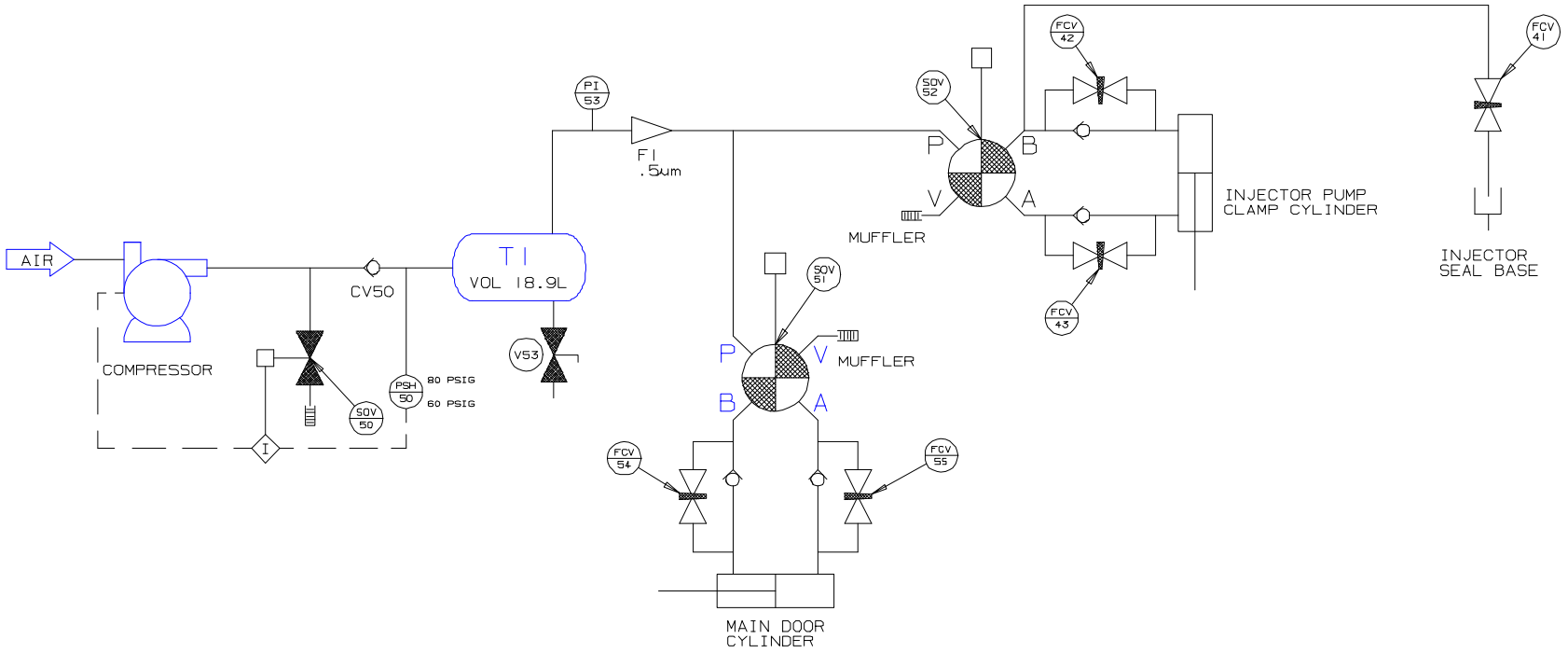

1,2 +5V
C73
3,4 GND
C3-C5,C14,C23-C27,C36
C45-C49,C58,C67-C72


BD0 - BD7
BRST*
M0AIN*
M7AIN*
RD2*
WR2*
U4
XX240
U3
XX273
M8AIN*
M15AIN*
RD1*
WR1*
U12
XX240
U11
XX273
M16AIN*
M23AIN*
RD0*
WR0*
U20
XX240
U19
XX273
U25
XX74
WR3*
R4
Q1
V1
R1
"PWR-A"
D1
C1
RP9
RP3
RP10
RP2
RP1
RP13
RP5
RP14
RP18
RP17
J1
MOD0A*
MOD1A*
MOD2A*
MOD3A*
MOD4A*
MOD5A*
MOD6A*
MOD7A*
MOD8A*
MOD9A*
MOD10A*
MOD11A*
MOD12A*
MOD13A*
MOD14A*
MOD15A*
MOD16A*
MOD17A*
MOD18A*
MOD19A*
MOD20A*
MOD21A*
MOD22A*
MOD23A*
2-50
ALL EVEN PINS
RACK POWER
49


BD0 - BD7
BRST*
M0BIN*
M7BIN*
RD6*
WR6*
U5
XX240
U6
XX273
U7
U8
M8BIN*
M15BIN*
RD5*
WR5*
U13
U14
U15
U16
M16BIN*
M23BIN*
RD4*
WR4*
U21
U22
U23
U24
BD7
WR7*
U25
XX74
R3
Q2
V2
R2
"PWR-B"
D2
C2
ALL EVEN PINS
RACK POWER
J2
MOD0B*
MOD1B*
MOD2B*
MOD3B*
MOD4B*
MOD5B*
MOD6B*
MOD7B*
MOD8B*
MOD9B*
MOD10B*
MOD11B*
MOD12B*
MOD13B*
MOD14B*
MOD15B*
MOD16B*
MOD17B*
MOD18B*
MOD19B*
MOD20B*
MOD21B*
MOD22B*
MOD23B*

NOTES:UNLESS OTHERWISE SPECIFIED
1.SOV 51 HAS $C_V$=0.3
2.SOV 52 HAS $C_V$=0.08
3.FCV 41 HAS $C_V$=0.0005

| | | | | |
|---|---|---|---|---|
| 1A | 972 | PRODUCTION RELEASE | SAS CH NN | 01/24/91 |
| 1B | 1064 | SEE CO 1064 | SAS | 07/11/91 |
| 1C | 1143 | BOM CHANGE ONLY | SAS CH HW | 11/4/91 |
| 1D | 4003 | T1 VOLUME WAS 7.6L | | |

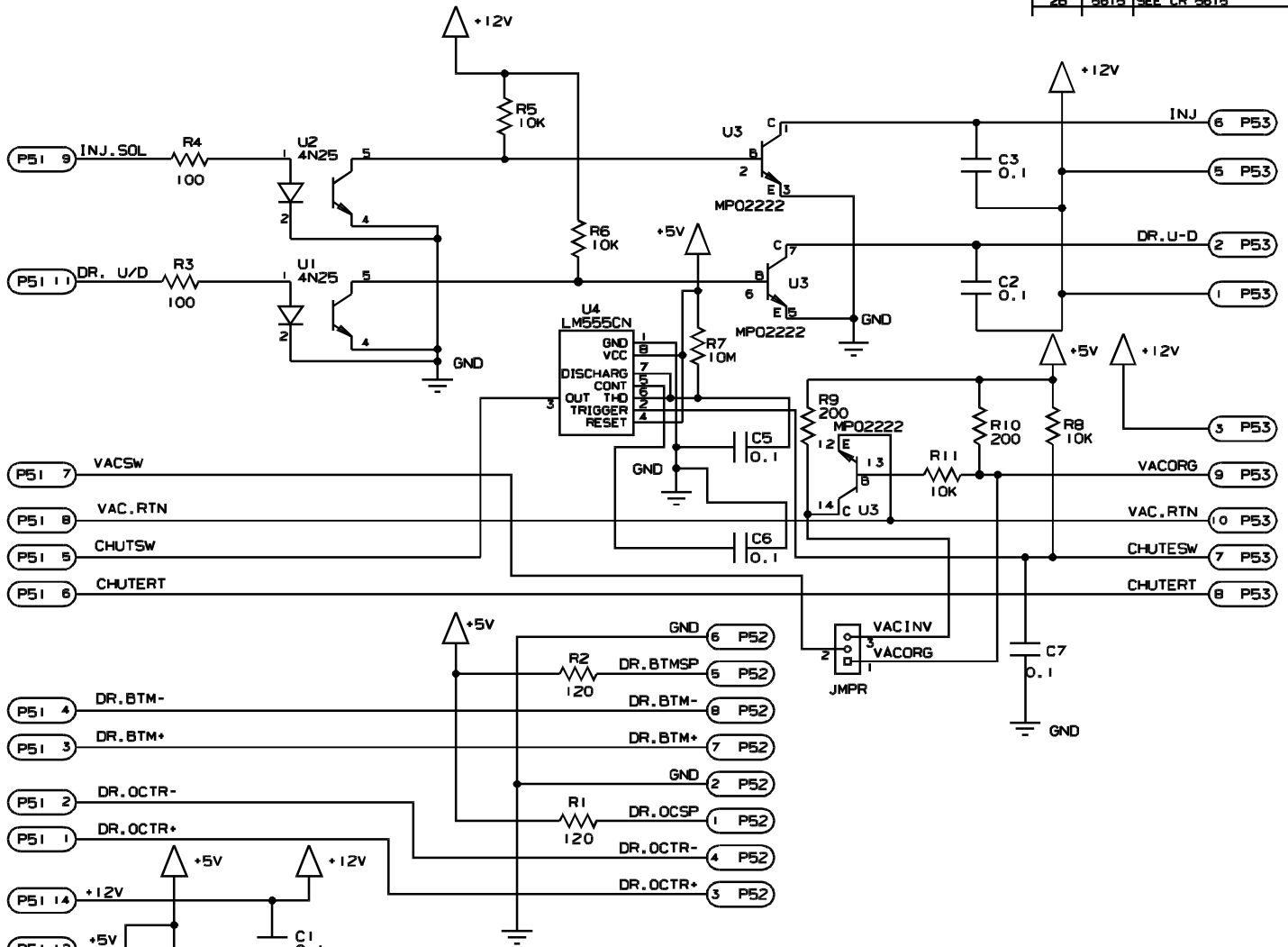



05 00189 10100

| | | |
|---|---|---|
| SS | 01/22/91 | FLOW SCHEMATIC, PNEUMATIC |
| CH | 01/24/91 | IO 00189 I 100 D |
| NN | 01/25/91 | NONE I I |

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITOR VALUES ARE IN MICROFARADS, ±10%.
2. ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/4 WATT.

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | DATE |
| 2A | 4408 | REVISED AND REDRAWN SAS | SH | NK | 08/01/94 |
| 2B | 5615 | SEE CR 5615 | | | |




| LAST USED |
|---|
| REF. DESIGNATOR |
| U4 |
| R11 |
| C7 |

| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|

PARTS LIST

METRIC

MATERIAL

FINISH

| | |
|---|---|
| 00 10100 | 10100 |
| NEXT ASSY | USED ON |
| APPLICATION | |

IRVINE, CALIFORNIA 92718

| APPROVED | DATE |
|---|---|
| S. SPHAR | 08/01/94 |
| S. HORTON | 08/01/94 |
| N. KIRMACI | 08/01/94 |

SCHEMATIC, PNEUMATIC PWA

10 00916 2 100 B

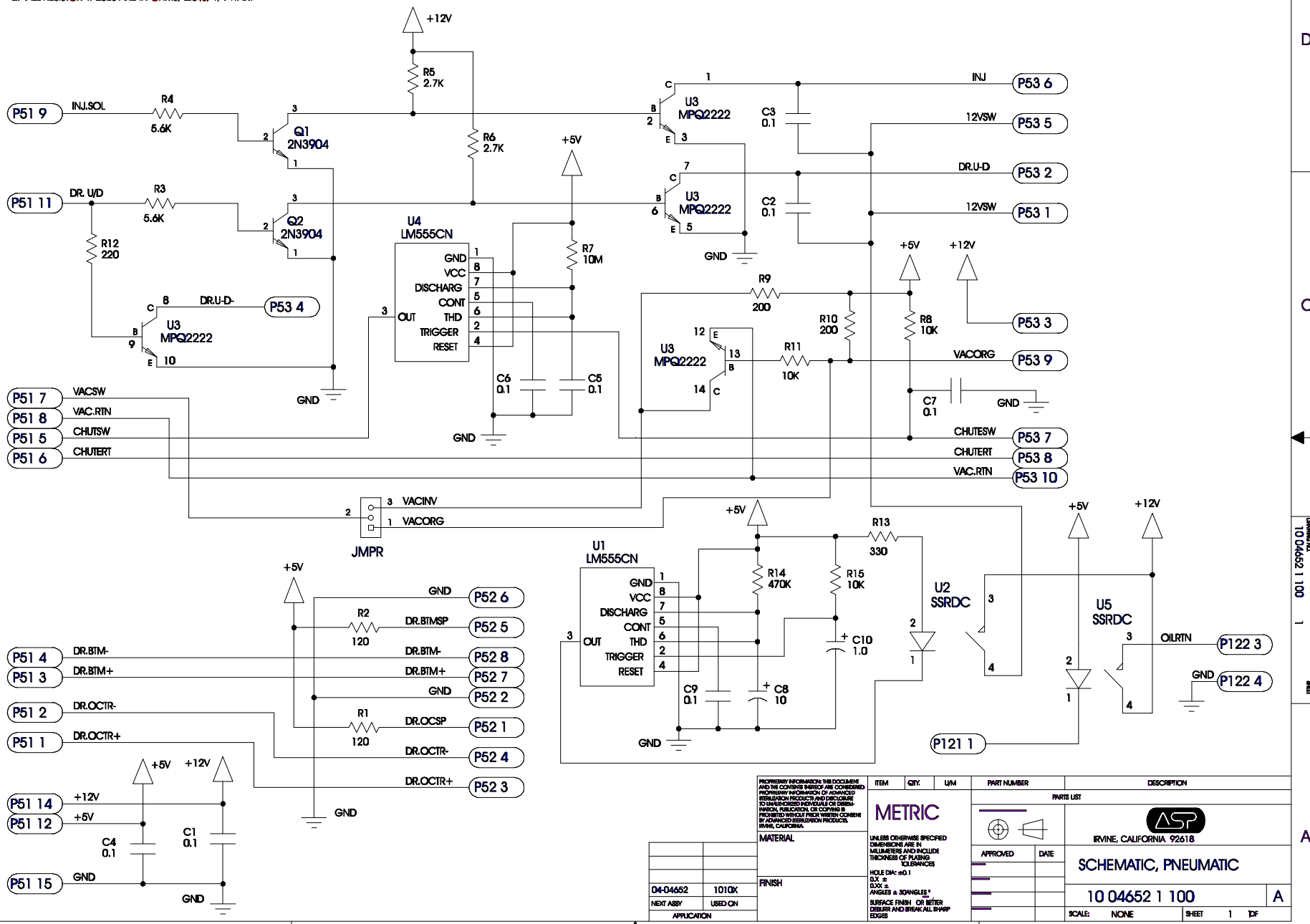
SCALE: NONE SHEET 1 OF 1

15-02986-001 REL 4/94

10 00916 2 100

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITOR VALUES ARE IN MICROFARADS, ±10%.
2. ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/4 WATT.

| REVISIONS | | | | |
|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | DATE |
| A | 7181 | PRODUCTION RELEASE | | |




| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| | | | PARTS LIST | |

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METRIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING TOLERANCES
HOLE DIA: ±0.1
0.X ±
0.XX ±
ANGLES ± 30'ANGLES °
SURFACE FINISH OR BETTER DEBURR AND BREAK ALL SHARP EDGES

MATERIAL

FINISH

| | |
|---|---|
| 04-04652 | 1010X |
| NEXT ASSY | USED ON |
| APPLICATION | |

| APPROVED | DATE |
|---|---|
| | |

ASP
IRVINE, CALIFORNIA 92618

SCHEMATIC, PNEUMATIC

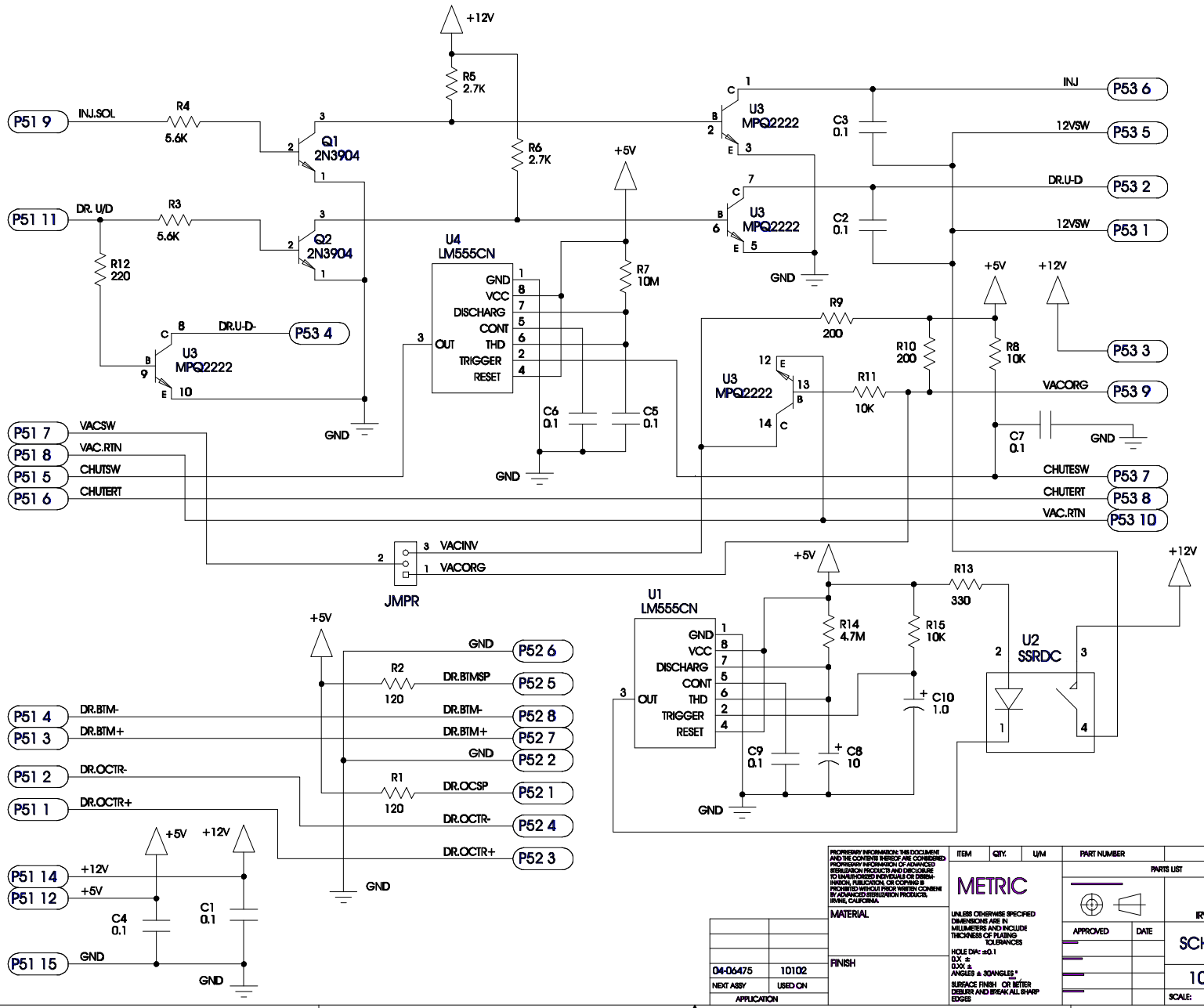
10 04652 1 100 A

SCALE: NONE SHEET 1 TOF

DRAWING NO. 10 04652 1 100 1 SHEET

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITOR VALUES ARE IN MICROFARADS, ±10%.
2. ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/4 WATT.

| REVISIONS | | | | |
|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | DATE |
| A | 7181 | PRODUCTION RELEASE | | |




| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| | | | PARTS LIST | |

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METRIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING TOLERANCES
HOLE DIA: ±0.1
0.X ±
0.XX ±
ANGLES ± 30ANGLES °
SURFACE FINISH OR BETTER DEBURR AND BREAK ALL SHARP EDGES

MATERIAL

FINISH

| | |
|---|---|
| 04-06475 | 10102 |
| NEXT ASSY | USED ON |
| APPLICATION | |

| APPROVED | DATE |
|---|---|
| | |

ASP
IRVINE, CALIFORNIA 92618

SCHEMATIC, PNEUMATIC

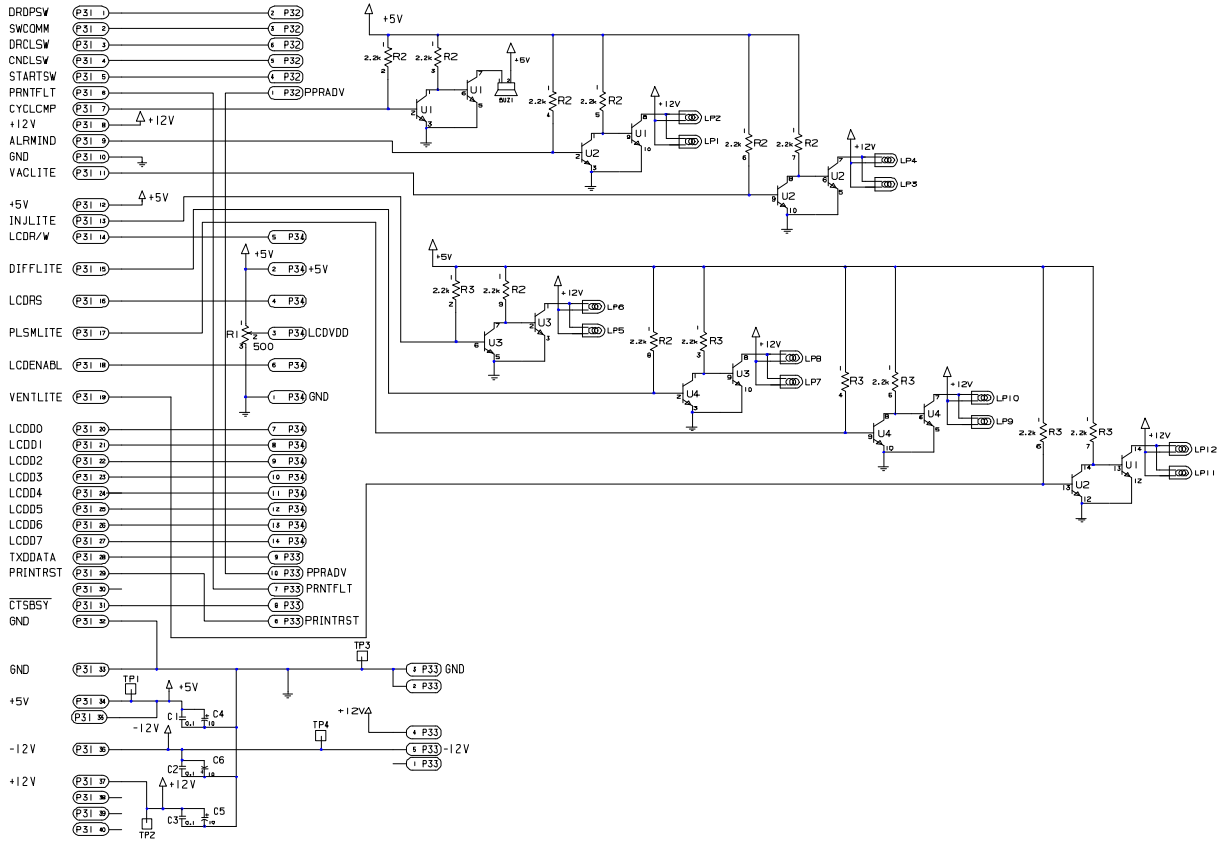
10 06475 0 100 A

SCALE: NONE SHEET 1 1DF

DRAWING NO. 10 06475 0 100 1 SHEET

OTES:UNLESS OTHERWISE SPECIFIED
.ALL RESISTOR VALUES ARE IN OHMS.
.ALL CAPACITOR VALUES ARE IN MICROFARADS.

| | | | | | | |
|---|---|---|---|---|---|---|
| A | 16 | PRODUCTION RELEASE | DD | CH | NK | SE 09/02/88 |
| D | 108 | RAISED REV LEVEL TO MATCH LEVEL OF 04 00952 001 | | CH | NK | SE 04/28/89 |
| E | 293 | RAISED REV LEVEL TO MATCH LEVEL OF 04 00952 001 | KA | CH | NK | SE 06/13/89 |
| F | 654 | BOM CHANGE ONLY | | | | |




| REF. DESIGNATOR | |
|---|---|
| ITEM | LAST USED |
| 27 | C6 |
| 7 | LP12 |
| 9 | R3 |
| 10 | BUZ1 |
| 15 | U4 |
| 28 | TP4 |

02 01103 ST100

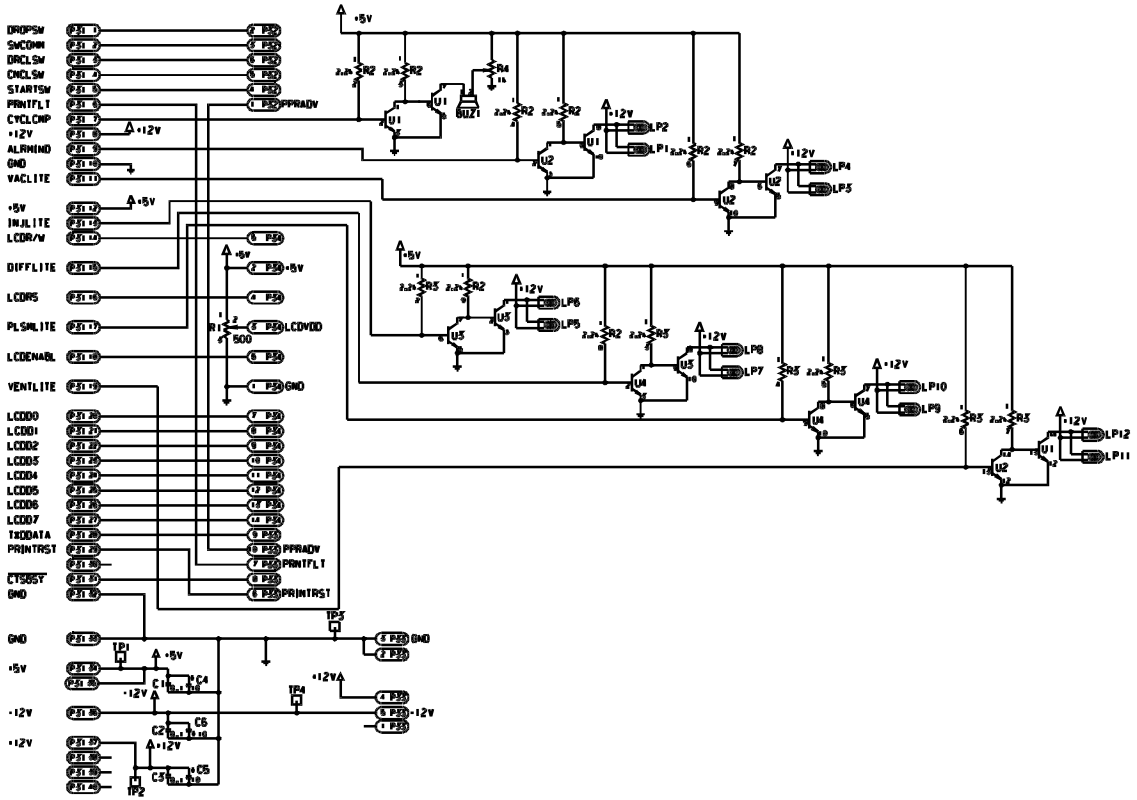
| | | |
|---|---|---|
| DD | 09/02/88 | SCHEMATIC, CONTROL PANEL PWB |
| CH | 09/02/88 | |
| NK | 09/02/88 | 10 00952 100 F |
| SE | 09/02/88 | NONE 1 1 |

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

DRAWING NO. 10 02324 0 100 SHEET 1/1

REVISIONS

| REV | ECO | DESCRIPTION | APPROVED | DATE |
|---|---|---|---|---|
| NA | 48824 | PRODUCTION RELEASE | SAS | 11/17/98 |
| NB | 49191 | SEE ON 49191 | RA | 07/30/99 |
| NC | 50517 | SEE ON 50517 | | |




| REFERENCE DESIGNATOR ITEM | LAST USED |
|---|---|
| 27 | C6 |
| 7 | LP12 |
| 9 | R4 |
| 10 | BUZ1 |
| 12 | U4 |
| 28 | TP4 |

| ITEM | QTY | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|

PARTS LIST

METRIC

THIRD ANGLE PROJECTION

[redacted]
IRVINE, CALIFORNIA 92718

| | | | |
|---|---|---|---|
| MATERIAL | | APPROVED | DATE |
| | | S. SPHAR | 11/17/98 |
| | | S. NORTON | 11/17/98 |
| FINISH | | | |
| 04 02324 | 10100 | | |
| NEXT ASSY | USED ON | N. KIRMACI | 11/17/98 |
| APPLICATION | | SCALE: NONE | SHEET 1 OF 1 |

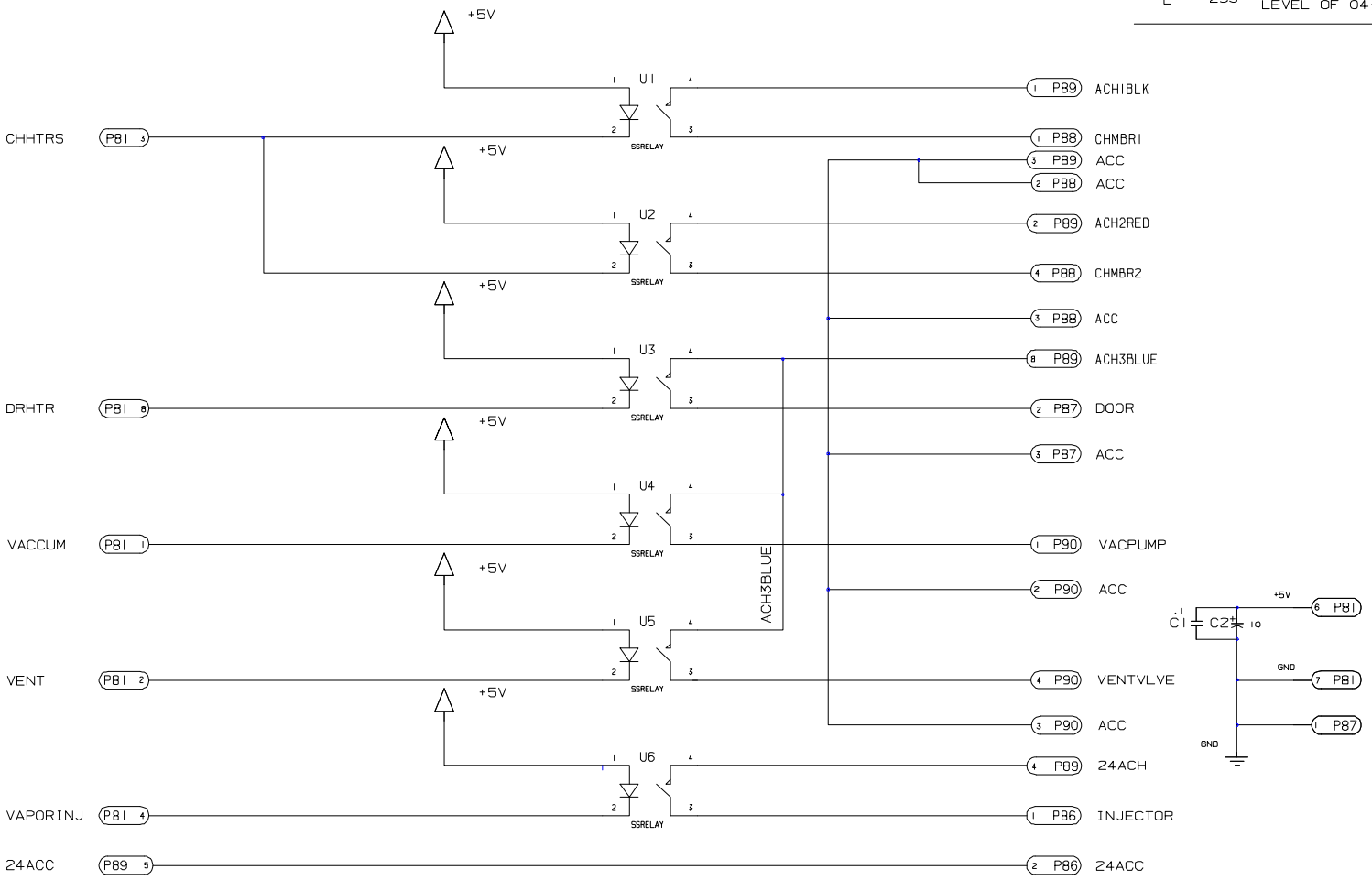
SCHEMATIC, CONTROL PANEL

10 02324 0 100 C

15-02997-001 REL 4/94

OTES; (UNLESS OTHERWISE NOTED)
. ALL CAPACITOR VALUES ARE IN MICROFARAD.

| | | | | | |
|---|---|---|---|---|---|
| A | 15 | PRODUCTION RELEASE | DD | NK | SE 9/2/88 |
| D | 108 | RAISED REV LEVEL TO MATCH LEVEL OF 04-00974-001 | CH | | SE 3/31/89 |
| E | 293 | RAISED REV LEVEL TO MATCH LEVEL OF 04-00974-001 | | | |







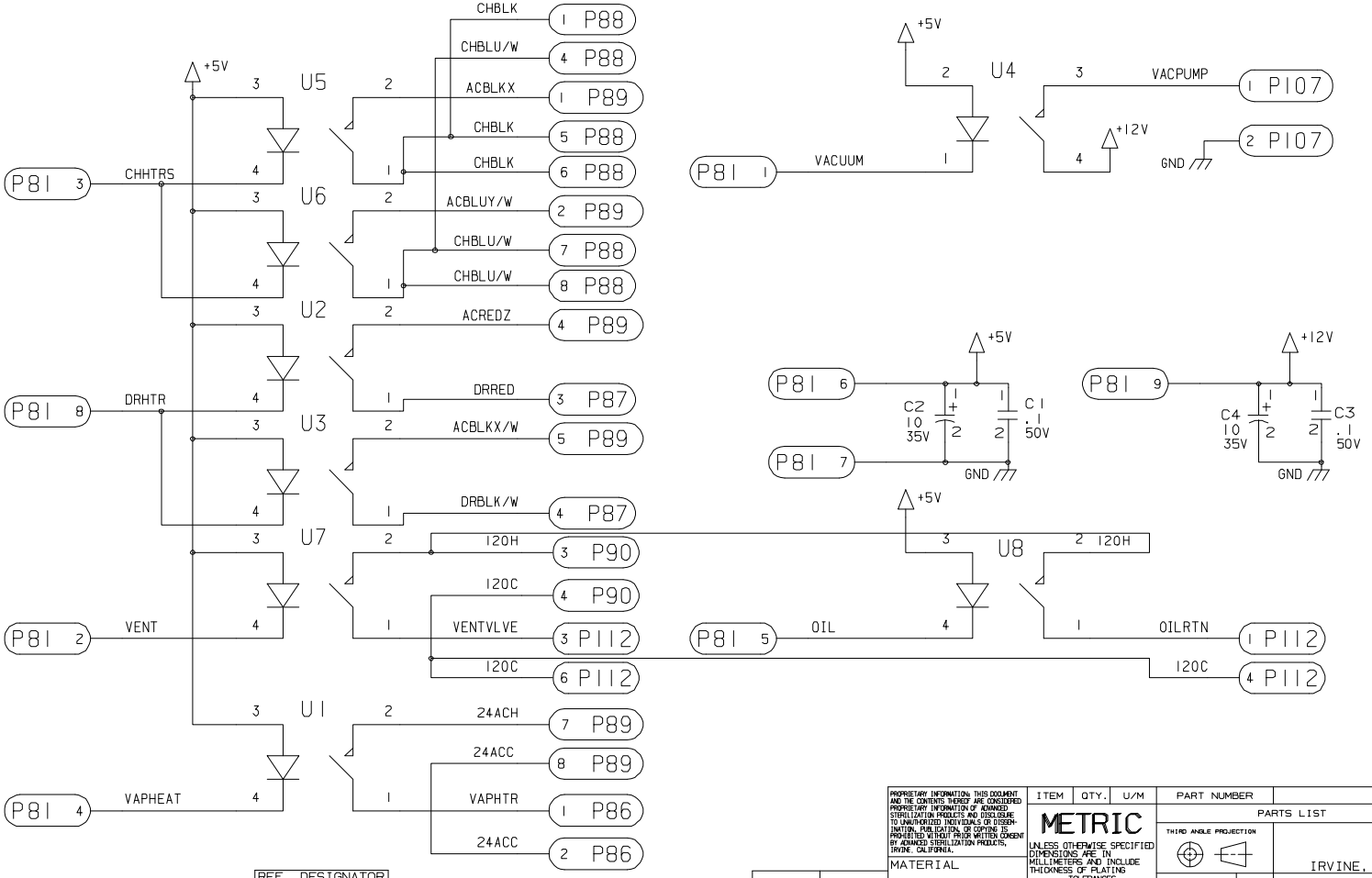
| REF. DESIGNATOR | |
|---|---|
| ITEM | LAST USED |
| 3 | U6 |
| 6 | C2 |



SCHEMATIC, PWA,
SOLID STATE RELAY
10-00974-100 E

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITOR VALUES ARE IN MICROFARADS.

| REVISIONS | | | | | | |
|---|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | | DATE |
| A | 3982 | PRODUCTION RELEASE | KA | | NK | 09/17/93 |
| B | 4469 | SEE CR 4469 | AQ | BW | NK | 10/04/94 |
| C | 5233 | SEE CR 5233 | AQ | | HW | 03/02/95 |
| D | 5618 | SEE CR 5618 | | | | |




| REF. DESIGNATOR | |
|---|---|
| ITEM | LAST USED |
| 3 | U8 |
| 6 | C4 |

| | |
|---|---|
| 04 02143 | 10100 |
| NEXT ASSY | USED ON |
| APPLICATION | |

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MATERIAL

FINISH

ITEM | QTY. | U/M

METRIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING

TOLERANCES

HOLE DIA: ±0.1

0.X ±
0.XX ±
ANGLES ± 30

SURFACE FINISH 1.6 OR BETTER DEBURR AND BREAK ALL SHARP EDGES

PART NUMBER | DESCRIPTION

PARTS LIST

THIRD ANGLE PROJECTION

| APPROVED | | DATE |
|---|---|---|
| DRAWN | KA | 09/17/93 |
| CHECKED | | |
| APPROVED | NK | 09/17/93 |
| APPROVED | | |

IRVINE, CALIFORNIA 92718

SCHEMATIC, PWA, SOLID STATE RELAY

10 02143 0 100 D

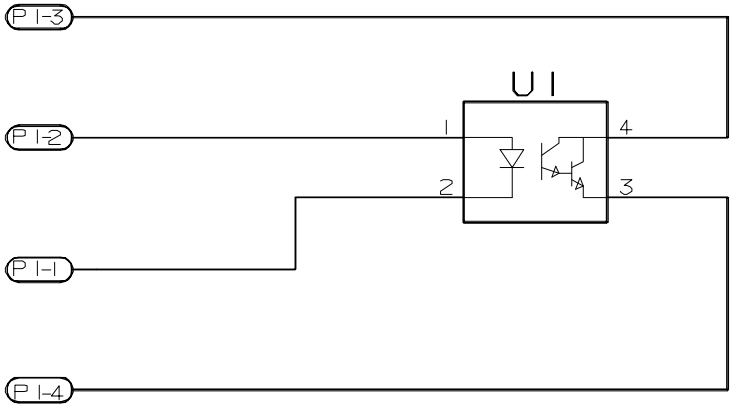
SCALE: NONE | SHEET 1 OF 1

15-02986-001 REL 10/94

DRAWING NO. 10 02143 0 100

DRAWING NO.
10 00975 100

| REVISIONS | | | | | | |
|---|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | | DATE |
| A | 22 | PRODUCTION RELEASE SAS | CH | | RMS | 08/29/88 |
| D | 108 | RAISED REV. LEVEL TO MATCH LEVEL OF 04 00975 | CH | | SE | 03/31/89 |
| E | 454 | RAISED REV. LEVEL TO MATCH LEVEL OF 04 00975 KA | CH | NK | SE | 09/05/89 |
| F | 860 | ADDED NHA 03 01220 AND 02 00180 | CH | NK | | 09/19/90 |
| G | 5616 | SEE CR 5616 | | | | |

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MATERIAL

FINISH

| APPLICATION | |
|---|---|
| 03 01220 | 10100 |
| 02 00180 | 10100 |
| 03 00979 | 10100 |
| 03 00989 | 10100 |
| NEXT ASSY | USED ON |

METRIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING

TOLERANCES

HOLE DIA: ±0.1

O.X ±
O.XX ±
ANGLES ± 30'

SURFACE FINISH $\sqrt{1.6}$ OR BETTER DEBURR AND BREAK ALL SHARP EDGES

| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| PARTS LIST | | | | |

THIRD ANGLE PROJECTION

| | APPROVED | DATE |
|---|---|---|
| DRAWN | SAS | 08/29/88 |
| CHECKED | CH | 08/29/88 |
| APPROVED | NK | 08/29/88 |
| APPROVED | RMS | 08/29/88 |

IRVINE, CALIFORNIA 92718

# SCHEMATIC, BOARD SENSOR

10 00975 100 G

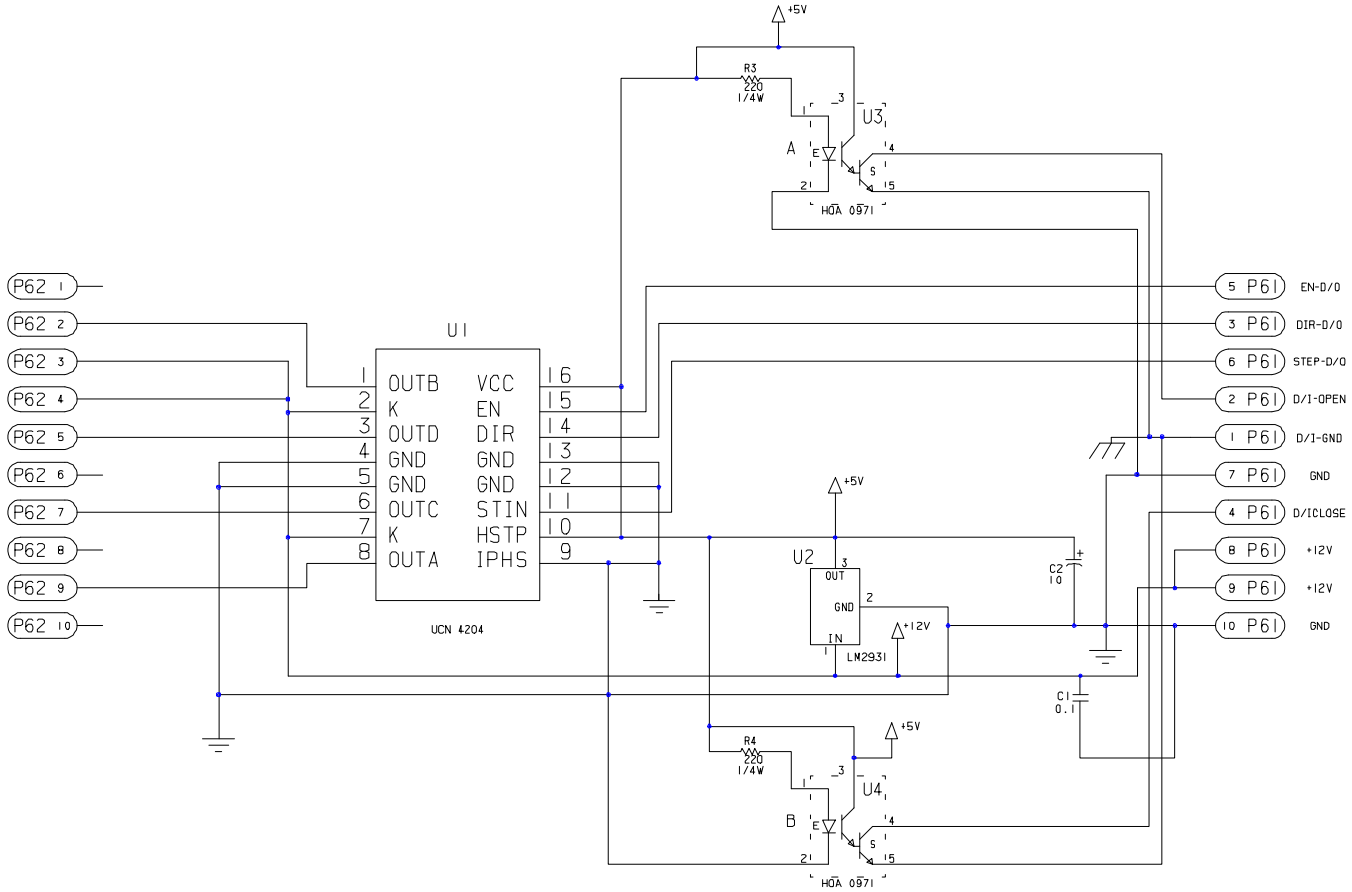
SCALE: NONE SHEET 1 OF 1

15-02985-001 REL 10/94

NOTES:UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL RESISTOR VALUES ARE IN OHMS.

REVISIONS

| REV | ECO | DECRIPTION | | APPVD | | | DATE |
|---|---|---|---|---|---|---|---|
| A | 23 | PRODUCTION RELEASE | SAS | | NK | SE | 12/13/88 |
| C | 131 | CHANGED REVISION TO MATCH LEVEL OF 04-01090-001 | KA | CH | NK | SE | 4/4/89 |
| D | 295 | CHANGED REVISION TO MATCH LEVEL OF 04-01090-001 | KA | CH | NK | SE | 6/13/89 |
| E | 489 | CHANGED REVISION TO MATCH LEVEL OF 04-01090-001 | KA | CH | NK | SE | 10/17/89 |
| F | 718 | DEL RESISTORS R1, R2; WAS: 10 OHM, 2W | | | | | |




| LAST USED | |
|---|---|
| ITEM | REF DESIGN |
| 4 | U4 |
| 9 | R4 |
| 11 | C2 |

| ITEM | QTY | PART NUMBER | DESCRIPTION |
|---|---|---|---|

MATERIAL

FINISH

| | |
|---|---|
| 04 01090 | ST100 |
| NEXT ASSY | USED ON |
| APPLICATION | |

| | | |
|---|---|---|
| DRAWN | SAS | 4/4/88 |
| CHECKED | | |
| APPROVED | NK | 12/13/88 |
| APPROVED | SE | 12/13/88 |

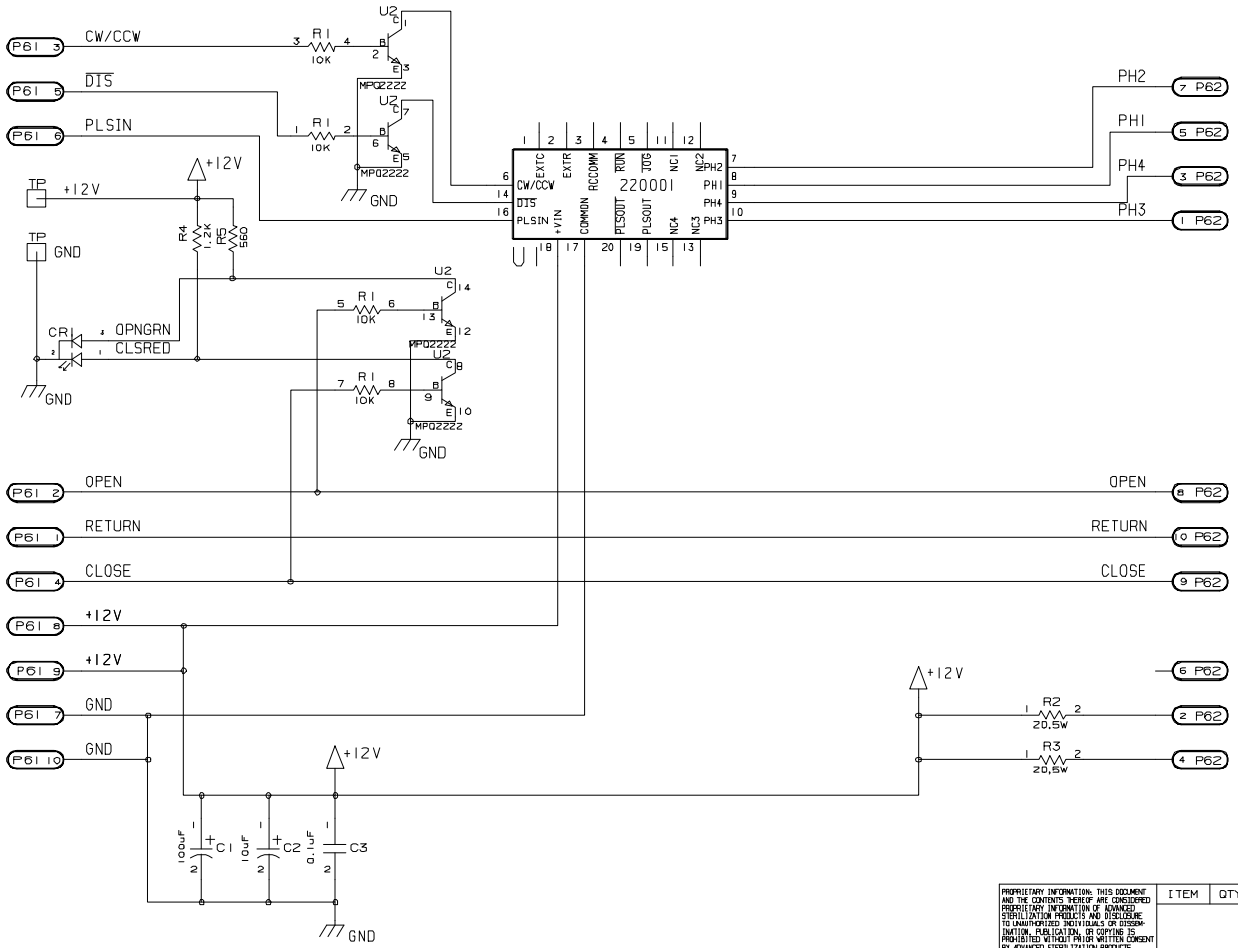
SCHEMATIC, PWA
STEPPER MOTOR DRIVER

D | 10 01090 100 F

SCALE NONE | SHEET OF

NOTES:UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL RESISTOR VALUES ARE IN OHMS, 5%, 1/4 WATT.

| REVISIONS | | | | | | |
|---|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | | DATE |
| A | | | | | | |
| | | | | | | |
| | | | | | | |




| LAST USED | |
|---|---|
| ITEM | REF. DESIGN. |
| 13 | C3 |
| 14 | CR1 |
| 10 | R5 |
| 5 | U2 |

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| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| | | | PARTS LIST | |

MATERIAL

FINISH

SURFACE FINISH OR RET

THIRD ANGLE PROJECTION

IRVINE, CALIFORNIA 92718

| | APPROVED | DATE |
|---|---|---|
| DRAWN | | 08/14/92 |
| CHECKED | | 08/17/92 |
| APPROVED | | 08/17/ |
| APPROVED | | |

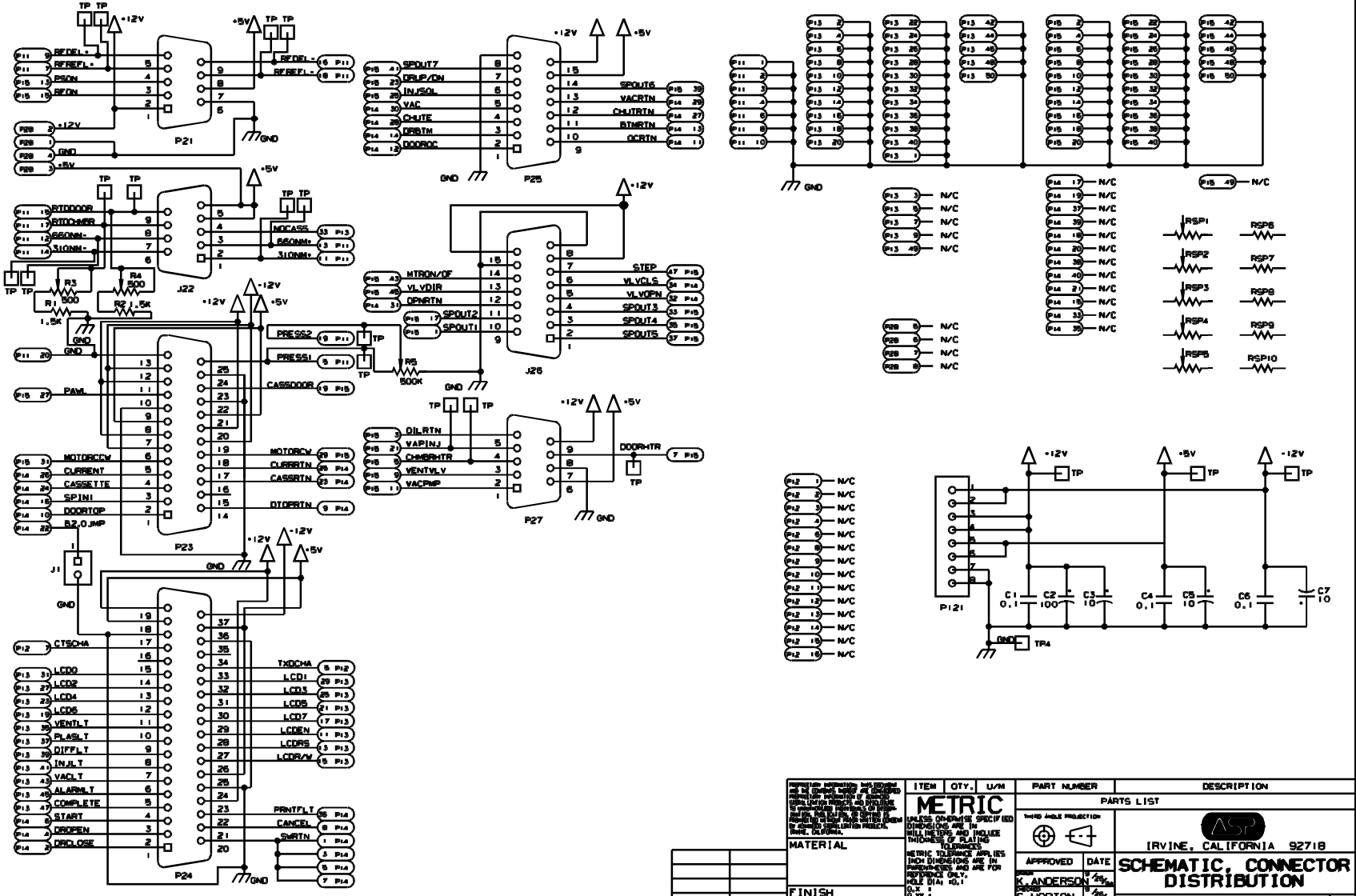
| 03 01705 | 10100 |
|---|---|
| NEXT ASSY | USED ON |
| APPLICATION | |

10 01707 0 100 C

SCALE: NONE SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/4 WATT.

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | DATE |
| 2A | 4405 | REVISED AND REDRAWN | KA | SEH / NK | 9/27/94 |
| 2B | 5531 | SEE CR 5531 | | | |




| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| | | | PARTS LIST | |

METRIC
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING TOLERANCES.
METRIC TOLERANCE APPLIES ONLY DIMENSIONS ARE IN PARENTHESES AND ARE FOR REFERENCE ONLY.
HOLE DIA: ±0.1
0.X ±
0.XX ±
ANGLES ± 30
SURFACE FINISH 125 OR BETTER BREAK ALL SHARP EDGES

MATERIAL

FINISH

THIRD ANGLE PROJECTION

ASP
IRVINE, CALIFORNIA 92718

| APPROVED | DATE |
|---|---|
| DRAWN K. ANDERSON | 9/27/94 |
| CHECKED S. HORTON | 9/27/94 |
| ENGINEER N. KIRMACI | 9/27/94 |

SCHEMATIC, CONNECTOR DISTRIBUTION

10 01766 2 100 B

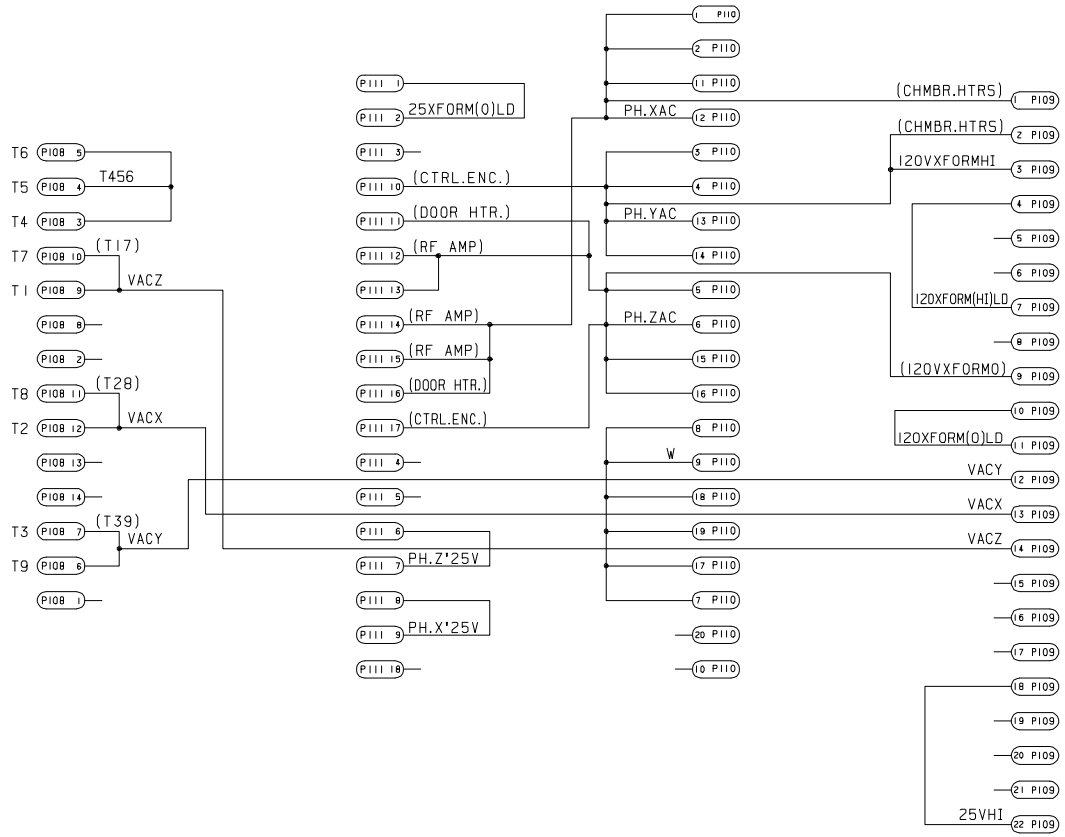
SCALE: NONE SHEET 1 OF 1

| 04 01766 | 10100 |
|---|---|
| NEXT ASSY | USED ON |
| APPLICATION | |

15-02986-001 REL 4/94

10 01766 2 100 REV B

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | DATE |
| 0A | 4823 | PRODUCTION RELEASE SAS | SH | NK | 11/10/94 |
| 0B | 5619 | SEE CR 5619 | | | |

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| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| | | | PARTS LIST | |

METRIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING

TOLERANCES

HOLE DIA: ±0.1

O.X ± -

O.XX ± -

ANGLES ± 0° 30'

SURFACE FINISH 1/0 OR BETTER DEBURR AND BREAK ALL SHARP EDGES

MATERIAL

-

FINISH

-

THIRD ANGLE PROJECTION

IRVINE, CALIFORNIA 92718

| | APPROVED | DATE |
|---|---|---|
| DRAWN | S.SPHAR | 11/07/94 |
| CHECKED | S.HORTON | 11/07/94 |
| APPROVED | | |
| APPROVED | N.KIRMACI | 11/10/94 |

SCHEMATIC, CONFIGURATION, 208 VAC

10 02195 0 101 B

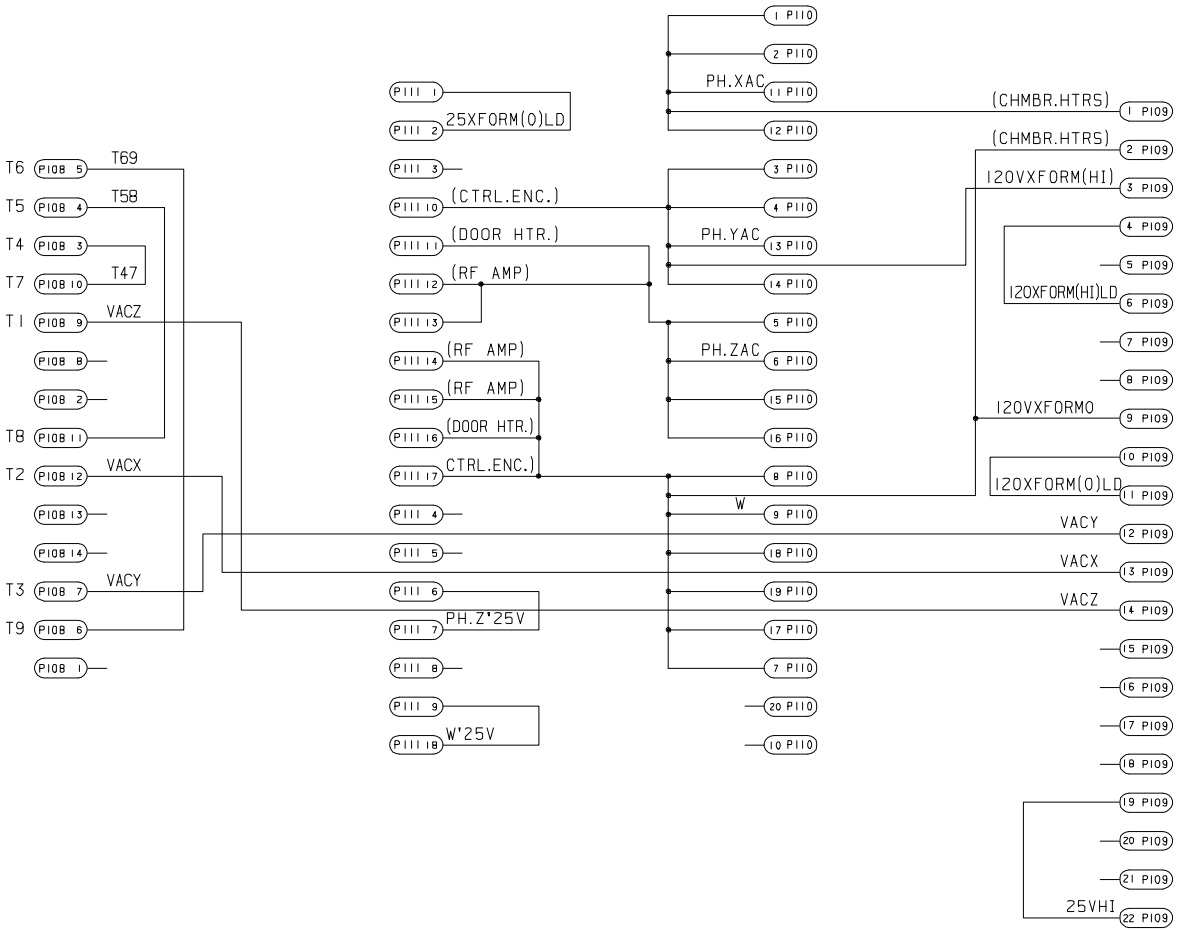
SCALE: NONE SHEET 1 OF 1

| | |
|---|---|
| | |
| | |
| | |
| 04 02195 | 10100 |
| NEXT ASSY | USED ON |
| APPLICATION | |

DRAWING NO 10 02195 0 101

15-02986-001 REL 4/94

| REVISIONS | | | | | | |
|---|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | | DATE |
| 0A | 4823 | PRODUCTION RELEASE SAS | SH | | NK | 11/10/94 |
| 0B | 5619 | SEE CR 5619 | | | | |

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| | |
|---|---|
| | |
| | |
| | |
| 04 02195 | 10100 |
| NEXT ASSY | USED ON |

MATERIAL
-

FINISH
-

METRIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING
TOLERANCES
HOLE DIA: ±0.1
O.X ± -
O.XX ± -
ANGLES ± 0° 30'
SURFACE FINISH 1.6 OR BETTER
DEBURR AND BREAK ALL SHARP

| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| | | | PARTS LIST | |

THIRD ANGLE PROJECTION

IRVINE, CALIFORNIA 92718

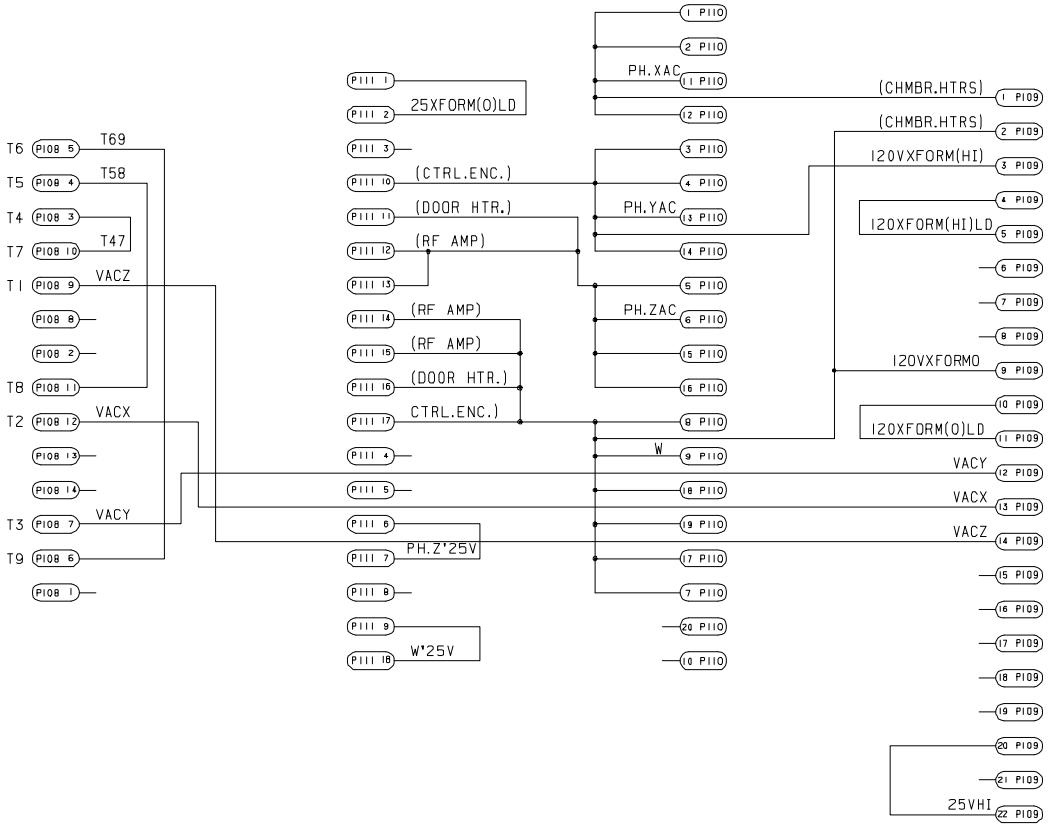
| | APPROVED | DATE |
|---|---|---|
| DRAWN | S.SPHAR | 11/07/94 |
| CHECKED | S.HORTON | 11/07/94 |
| APPROVED | | |

SCHEMATIC, CONFIGURATION, 380 VAC

10 02195 0 102 B

10 02195 0 102

| REVISIONS | | | | | | |
|---|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | | DATE |
| 0A | 4823 | PRODUCTION RELEASE SAS | SH | | NK | 11/10/94 |
| 0B | 5619 | SEE CR 5619 | | | | |




DRAWING NO. 10 02195 0 103

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| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| | | | PARTS LIST | |

METRIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING
TOLERANCES
HOLE DIA: ±0.1
0.X ± -
0.XX ± -
ANGLES ± 0° 30'
SURFACE FINISH 1 V OR BETTER DEBURR AND BREAK ALL SHARP EDGES

MATERIAL -

FINISH -

THIRD ANGLE PROJECTION

ASP IRVINE, CALIFORNIA 92718

| | APPROVED | DATE |
|---|---|---|
| DRAWN | S. SPHAR | 11/07/94 |
| CHECKED | S. HORTON | 11/07/94 |
| APPROVED | N. KIRMACI | 11/10/94 |

SCHEMATIC, CONFIGURATION, 398 VAC

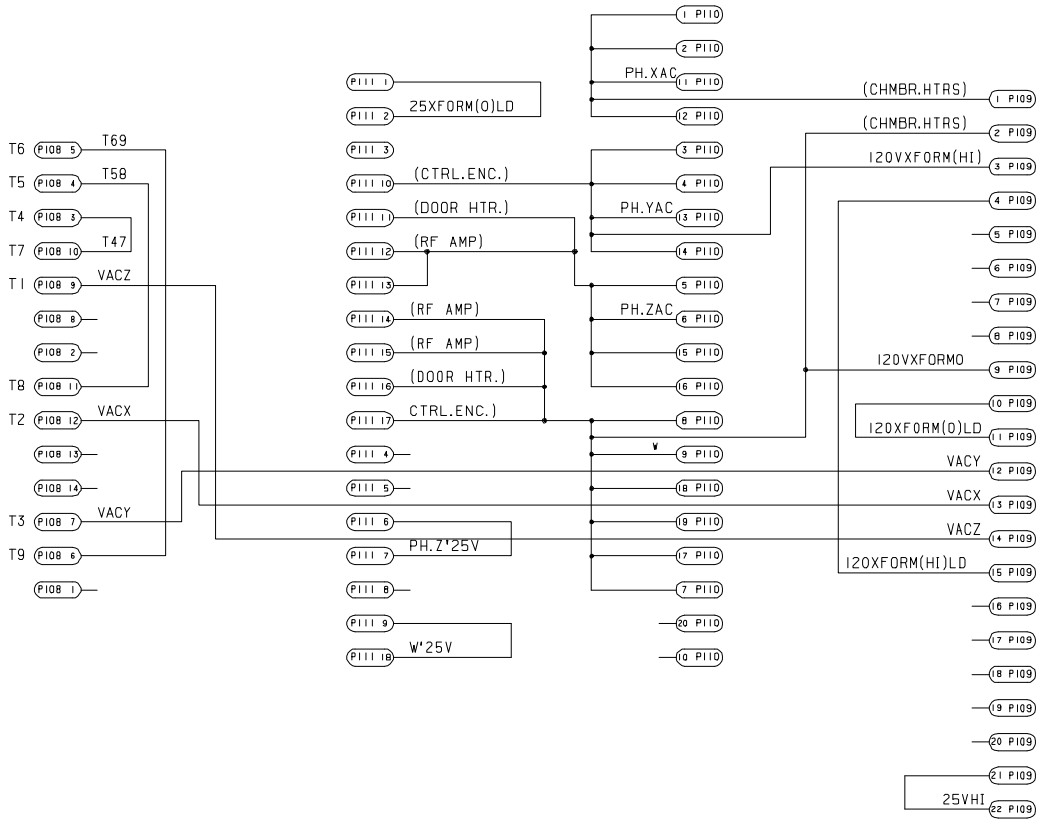
10 02195 0 103 B

SCALE: NONE SHEET 1 OF 1

| | |
|---|---|
| 04 02195 | 10100 |
| NEXT ASSY | USED ON |
| APPLICATION | |

15-02986-001 REL 4/94

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | DATE |
| 0A | 4823 | PRODUCTION RELEASE SAS | SH | NK | 11/10/94 |
| 0B | 5619 | SEE CR 5619 | | | |




10 02195 0 104 CN: UNASSIGNED

| | |
|---|---|
| 04 02195 | 10100 |
| NEXT ASSY | USED ON |
| APPLICATION | |

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MATERIAL
-

FINISH
-

ITEM | QTY. | U/M

METRIC
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING
TOLERANCES
HOLE DIA: ±0.1
0.X ± -
0.XX ± -
ANGLES ± 30°
SURFACE FINISH 63 OR BETTER
DEBURR AND BREAK ALL SHARP EDGES

PART NUMBER | DESCRIPTION

PARTS LIST

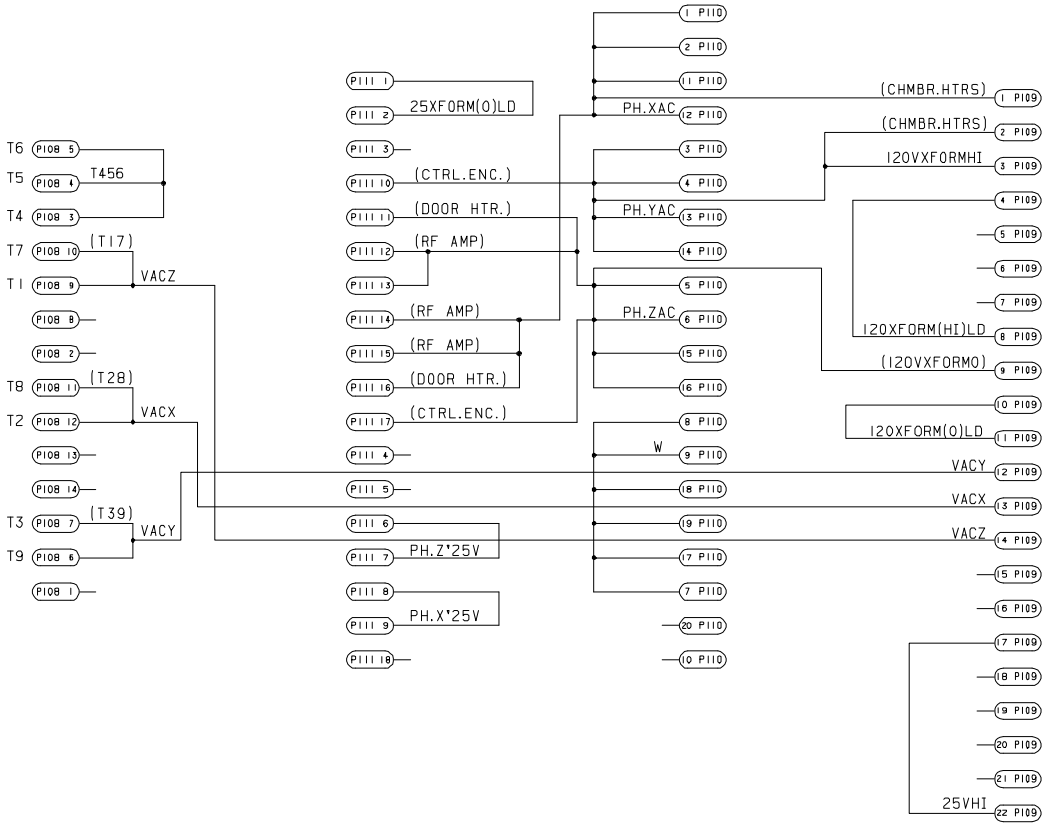
THIRD ANGLE PROJECTION

IRVINE, CALIFORNIA 92718

| | | |
|---|---|---|
| APPROVED | DATE | |
| DRAWN S.SPHAR | 11/07/94 | SCHEMATIC, CONFIGURATION, 415 VAC |
| CHECKED S.HORTON | 11/07/94 | 10 02195 0 104 B |
| APPROVED N.KIRMACI | 11/10/94 | SCALE: NONE SHEET 1 OF 1 |

15-02986-001 REL 4/94

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | | DATE |
| 0A | 4823 | PRODUCTION RELEASE SAS | SH | NK | 11/10/94 |
| 0B | 5619 | SEE CR 5619 | | | |




DRAWING NO. 10 02195 0 106

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| ITEM | QTY. | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|
| | | | PARTS LIST | |

METRIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING TOLERANCES

HOLE DIA: ±0.1

0.X ± -

0.XX ± -

ANGLES ± 0° 30'

SURFACE FINISH 1 % OR BETTER DEBURR AND BREAK ALL SHARP EDGES

THIRD ANGLE PROJECTION

MATERIAL -

FINISH -

| | |
|---|---|
| | |
| | |
| | |
| 04 02195 | 10100 |
| NEXT ASSY | USED ON |
| APPLICATION | |

| | APPROVED | DATE |
|---|---|---|
| DRAWN | S. SPHAR | 11/07/94 |
| CHECKED | S. HORTON | 11/07/94 |
| APPROVED | | |
| APPROVED | N. KIRMACI | 11/10/94 |

ASP
IRVINE, CALIFORNIA 92718

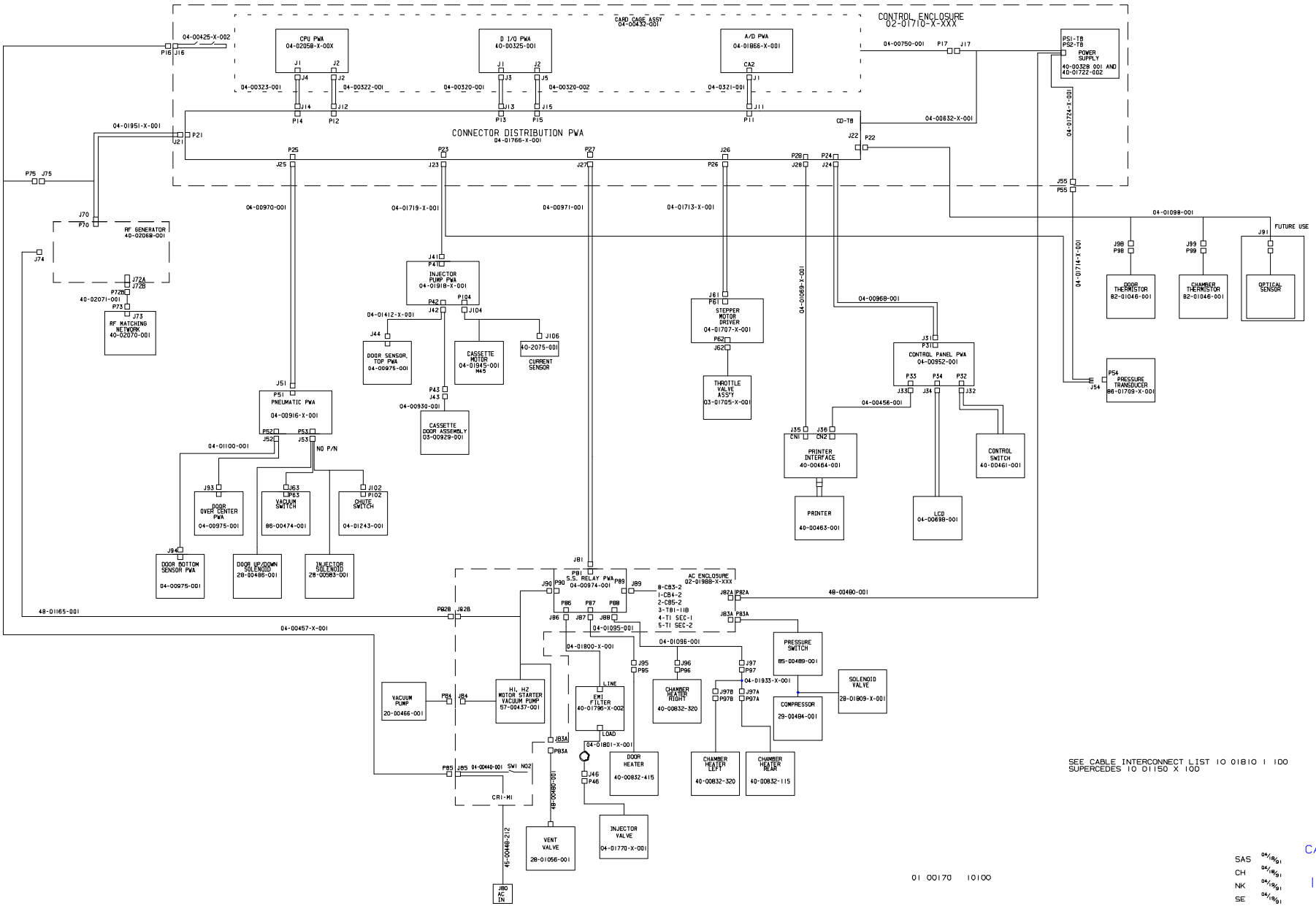
SCHEMATIC, CONFIGURATION, 200 VAC

10 02195 0 106 B

SCALE: NONE SHEET 1 OF 1

15-02986-001 REL 4/94

| | | | | | |
|---|---|---|---|---|---|
| 0A | 988 | PRODUCTION RELEASE | SAS | CH | NK | SE | 04 |
| 1A | 1077 | SEE DC1077-1 | | | | | |



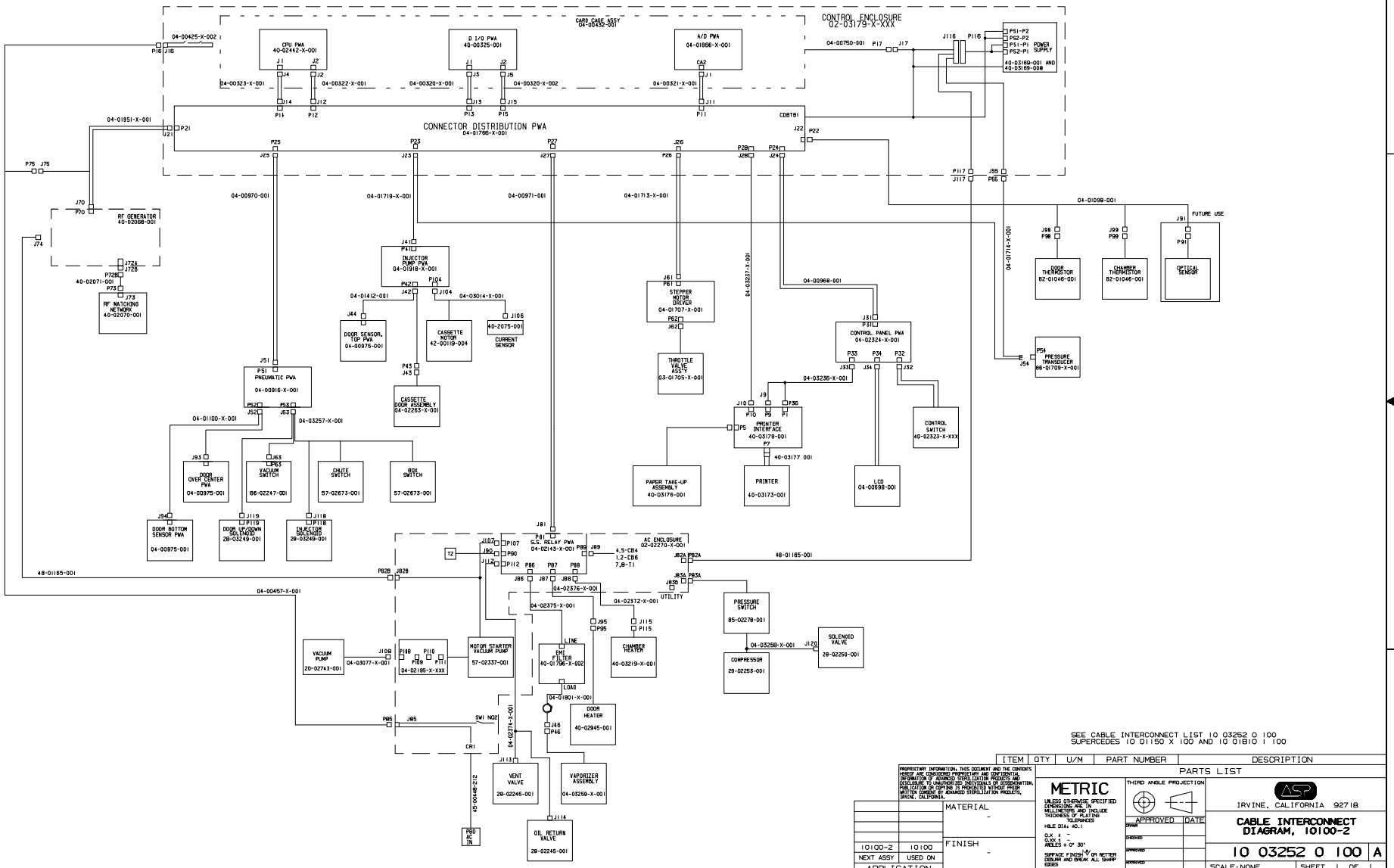

SEE CABLE INTERCONNECT LIST IO 01810 1 100
SUPERCEDES IO 01150 X 100

01 00170 10100

| | | CABLE INTERCONNECT DIAGRAM, 10100 |
|---|---|---|
| SAS | 04/18/91 | IO 01810 1 100 |
| CH | 04/18/91 | |
| NK | 04/19/91 | |
| SE | 04/19/91 | NONE 1 |

DRAWING NO. 10 03252 0 100 SHEET 1/1

| REVISIONS | | | | |
|---|---|---|---|---|
| REV | ECO | DESCRIPTION | APPROVED | DATE |
| DA | 4899 | PRODUCTION RELEASE | | |




SEE CABLE INTERCONNECT LIST 10 03252 0 100
SUPERCEDES 10 01150 X 100 AND 10 01810 1 100

| ITEM | QTY | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|

PARTS LIST

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| | |
|---|---|
| | MATERIAL - |
| | FINISH - |
| 10100-2 | 10100 |
| NEXT ASSY | USED ON |
| APPLICATION | |

METRIC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING TOLERANCES
HOLE DIA: ±0.1
0.X ± -
0.0X ± -
ANGLES ± 0° 30'
SURFACE FINISH 63 OR BETTER DEBURR AND BREAK ALL SHARP EDGES

THIRD ANGLE PROJECTION

| | APPROVED | DATE |
|---|---|---|
| DRAWN | | |
| CHECKED | | |
| APPROVED | | |
| RELEASED | | |

ASP
IRVINE, CALIFORNIA 92718

CABLE INTERCONNECT DIAGRAM, 10100-2

10 03252 0 100 A

SCALE: NONE SHEET 1 OF 1

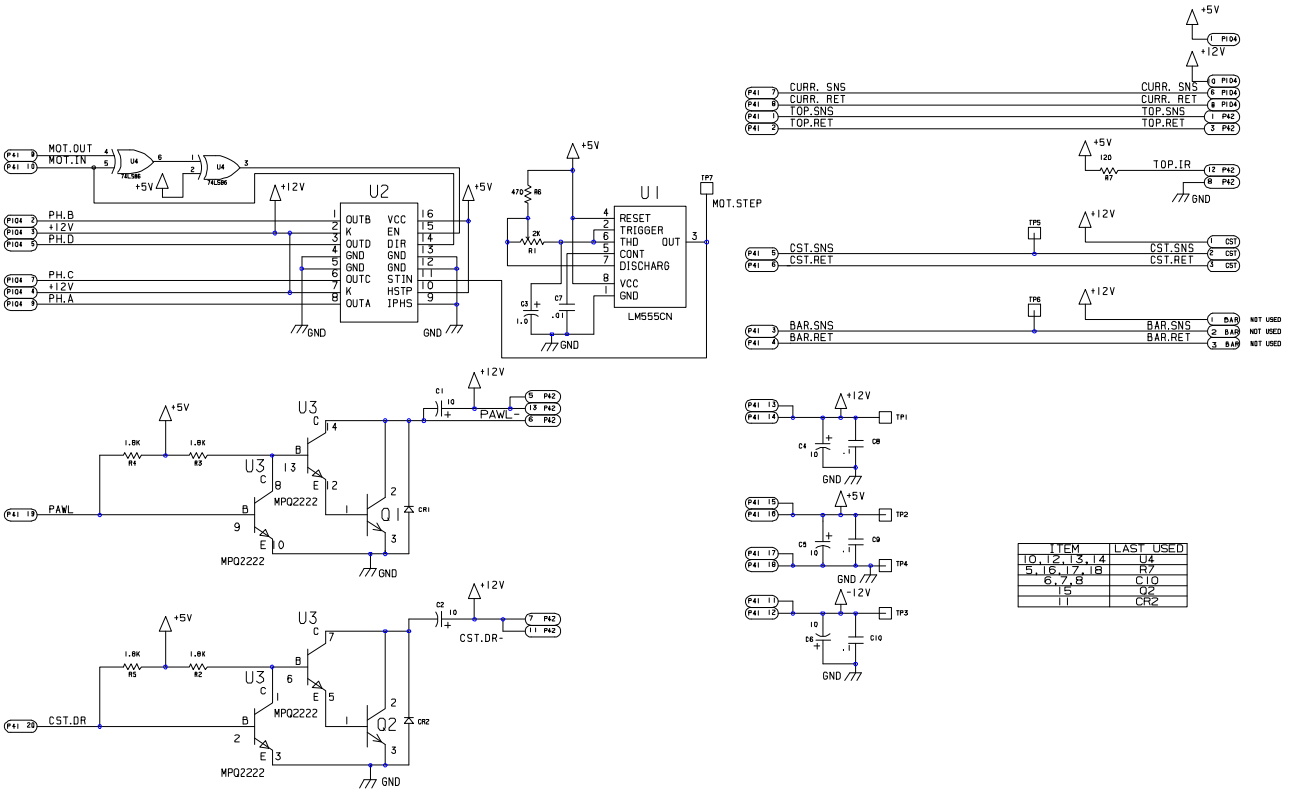
IS-02987-001 REL 10/94

DRAWING NO. 10 01918 0 100 SHEET 1/1

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL RESISTOR VALUES ARE IN OHMS, ±5%, 1/4 WATT.

**REVISIONS**

| REV | ECO | DESCRIPTION | APPROVED | | | DATE |
|---|---|---|---|---|---|---|
| A | 10857 | PRODUCTION RELEASE | KM | CH | SE | NK | 08/05/91 |
| B | 3981 | SEE CR 3981 | | CH | SE | NK | 05/31/93 |
| C | 4541 | SEE CR 4541 | | | | | |




| ITEM | LAST USED |
|---|---|
| 10, 12, 13, 14 | U4 |
| 5, 16, 17, 18 | R7 |
| 6, 7, 8 | C10 |
| 15 | Q2 |
| 11 | CR2 |

SUPERCEDES 10-00944-100

| ITEM | QTY | U/M | PART NUMBER | DESCRIPTION |
|---|---|---|---|---|

PARTS LIST

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METRIC
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND INCLUDE THICKNESS OF PLATING
TOLERANCES
HOLE DIA: ±0.1
O.X ±
O.XX ±
ANGLES ± 30
SURFACE FINISH 63 OR BETTER DEBURR AND BREAK ALL SHARP EDGES

THIRD ANGLE PROJECTION

| | APPROVED | DATE |
|---|---|---|
| DRAWN | KM | 08/05/91 |
| CHECKED | CH | 08/05/91 |
| APPROVED | | |
| APPROVED | SE | 08/05/91 |

MATERIAL
FINISH

| | |
|---|---|
| 04 01918 | 10100 |
| NEXT ASSY | USED ON |
| APPLICATION | |

ASP
IRVINE, CALIFORNIA 92718

SCHEMATIC, INJECTOR PUMP, PWA

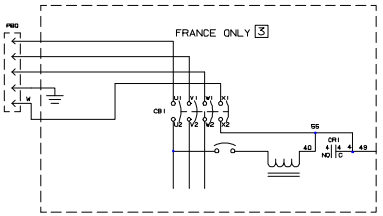
10 01918 0 100 C

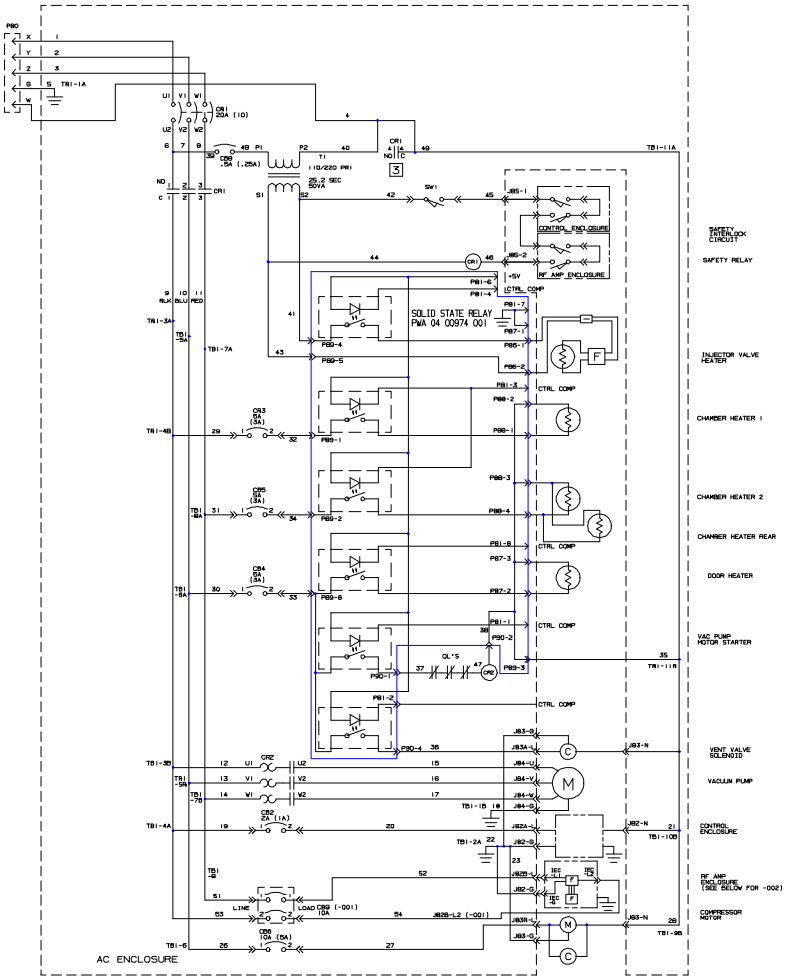
SCALE: NONE SHEET 1 OF 1

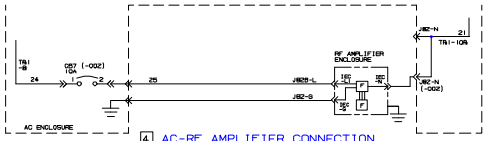
15-02987-001 REL 10/94

NOTES:UNLESS OTHERWISE SPECIFIED
1. CIRCUIT BREAKER (CB#) VALUES ARE GIVEN IN AMPS FOR -001 VERSION 208 VAC/60Hz AND IN PARENTHESES (IN AMPS) FOR -002 VERSION 380 VAC/50Hz.
2. THE DIAGRAM SHOWS CONNECTION OF ALL MAINS COUPLED DEVICES, NOT JUST OF THE 02-01774-1-XXX AC INTERFACE ENCLOSURE
3. 4 POLE CIRCUIT BREAKER TO BREAK "NEUTRAL" TO BE INSTALLED IN FRENCH MACHINES.
4. VERSION -001 IS 208V LINE TO LINE, USES DOUBLE POLE BREAKER (CB9). VERSION -002 IS 220V LINE TO NEUTRAL, USES SINGLE POLE BREAKER (CB7).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0A | 1060 | PRODUCTION RELEASE | KM | CH | NK | SE | 08/06/91 |
| 0B | 1200 | SEE DC1200-1 | SAS | CH | | SE | |
| 0C | 3079 | SEE C03079 | SAS | | | HW | 5/7/92 |
| 0D | 3856 | ILLUSTRATED THE FRENCH WIRING | KA | CH | NK | HW | 11/24/92 |
| 0E | 4303 | REMOVED LABEL FROM AC ENCLOSURE | | | | | |
| | 4436 | ADDED NOTE 5 TO 02-01988-0-XXX | | | | | |



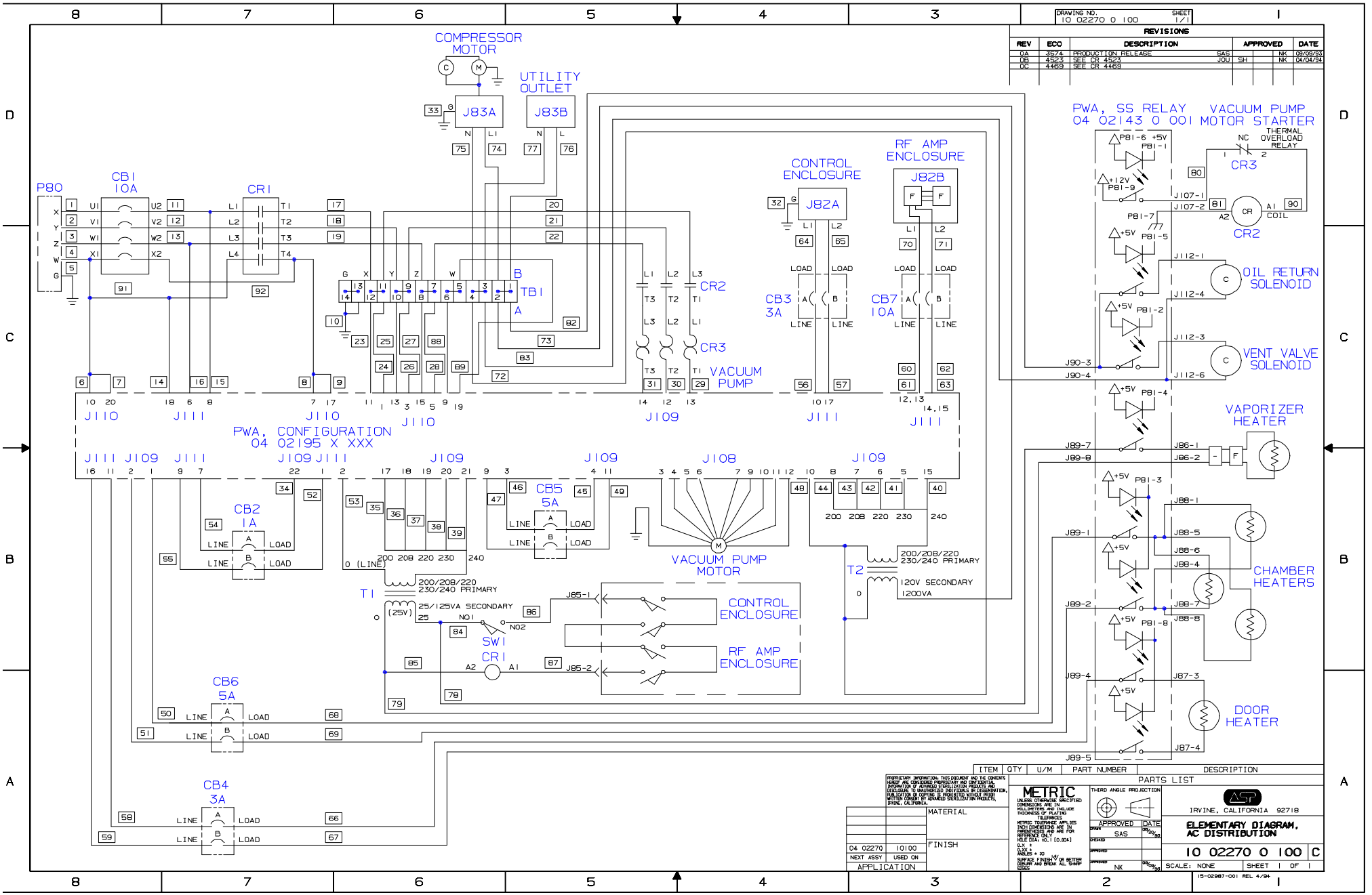

4 AC-RF AMPLIFIER CONNECTION FOR VERSION -002

| LEGEND | |
|---|---|
| SYMBOL | DESCRIPTION |
| M | MOTOR |
| CR | COIL (RELAY) |
| | HEATER |
| | SOLID STATE RELAY |
| | RELAY CONTACT-NO (NC) |
| | CHASSIS GROUND |
| | (NO) POSITION SENSING SWITCH |
| | CIRCUIT BREAKER |
| | MOTOR CIRCUIT THERMAL OVERLOAD DEVICES |
| | PLUG/JACK |
| | TRANSFORMER |
| C | PNEUMATIC DUMP VALVE |
| F | EMI FILTER |
| | FERRITE BEAD |

SUPERCEDES 10 01774 1 1XX

01 00170 10100

| | | |
|---|---|---|
| KM | 08/06/91 | DIAGRAM, ELEMENTARY, AC DISTRIBUTION |
| CH | 08/06/91 | |
| NK | 08/06/91 | 10 01988 0 1XX E |
| SE | 08/06/91 | NONE 1 1 |


DRAWING NO. 10 02270 0 100
SHEET 1/1
REVISIONS
REV ECO DESCRIPTION APPROVED DATE
0A 3674 PRODUCTION RELEASE SAS NK 09/09/93
0B 4523 SEE CR 4523 JOU SH NK 04/04/94
0C 4469 SEE CR 4469
COMPRESSOR MOTOR
UTILITY OUTLET
J83A
J83B
P80
CB1 10A
CR1
TB1
CONTROL ENCLOSURE
J82A
RF AMP ENCLOSURE
J82B
CB3 3A
CB7 10A
CR2
CR3
VACUUM PUMP
PWA, SS RELAY VACUUM PUMP MOTOR STARTER
04 02143 0 001
THERMAL OVERLOAD RELAY
OIL RETURN SOLENOID
VENT VALVE SOLENOID
VAPORIZER HEATER
CHAMBER HEATERS
DOOR HEATER
PWA, CONFIGURATION
04 02195 X XXX
CB2 1A
CB5 5A
CB6 5A
CB4 3A
VACUUM PUMP MOTOR
T1
T2
200/208/220 230/240 PRIMARY
25/125VA SECONDARY
120V SECONDARY 1200VA
SW1
CR1
ITEM QTY U/M PART NUMBER DESCRIPTION
PARTS LIST
METRIC
IRVINE, CALIFORNIA 92718
ELEMENTARY DIAGRAM, AC DISTRIBUTION
10 02270 0 100 C
SCALE: NONE SHEET 1 OF 1
15-02987-001 REV 4/94